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A Semi-monthly Abstract Journal with Indexes

July 8, 1963

VOLUME 1 NUMBER 13

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Scientific and Technical Aerospace Reports, Volume 1, is prepared by the Scientific and Technical Information Facility, operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, December 20, 1962

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For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics

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Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

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01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-15796 Congress. House. Committee on Science and Astronautics

THE NATIONAL BUREAU OF STANDARDS AND THE SPACE PROGRAM Hearings Before the Committee on Science and Astronautics, U.S. House of Representatives May 11-12, 1961

A. V. Astin et al. Washington, GPO, 1961 71 p
(87th Cong. 1st Sess. Committee Print [No. 9])

Statements by the director and other employees of the National Bureau of Standards are presented. It is emphasized that the Bureau has been contributing much toward the space effort in terms of measurements and calibrations which have enabled data, from space telemetered back to earth, to be examined qualitatively. Radio waves at all frequencies along the surface of the earth, in the atmosphere, and in space are studied at the Bureau's Radio Propagation Laboratory at Boulder, Colorado. Mention was made of the desire to improve the standards for radio, temperature, force, and pressure. J.A.J.

N63-15811 Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge

Quarterly Progress Report [For the Period Ending Feb. 28, 1963] [RADIO PHYSICS, PLASMA DYNAMICS, COMMUNICATION SCIENCES AND ENGINEERING]

H. J. Zimmerman et al. Apr. 15, 1963 273 p refs
(Contracts DA-36-039-sc-78108, AT(30-1)-1842, AF 19(604)-5992, and AF 33(616)7624; and Grants DA-SIG-36-039-61-G14, NSF-G-24073; NSF-G-16526, and NIH-MH-04737-02)

Reports of progress in radio physics, plasma dynamics, communication sciences and engineering are presented. Particular attention has been given to investigations in microwave spectroscopy, microwave electronics, molecular beams, radio astronomy, noise in electron devices, plasma physics, plasma electronics, plasma magnetohydrodynamics and energy conversion, statistical communication theory, processing and transmission information, artificial intelligence, speech communication, mechanical translation, linguistics, communications biophysics, neurophysiology, and neurology. J.A.J.

N63-15812 North Carolina U., Chapel Hill

ESTIMATION AND TESTING OF PARAMETERS OF DISTRIBUTIONS BY ORDER STATISTICS Semi-Annual Progress Report No. 6 and Final Report, Apr. 1, 1960-Mar. 31, 1963

Bernard G. Greenberg [1963] 5 p 13 refs
(Grant DA-ORD-7-2776-M)
(AROD-2776-11)

The reports and publications resulting from this grant are outlined and the operating budget is presented. R.C.M.

N63-15814 System Analysis and Research Corp., Boston, Mass.

COMPARATIVE COST ANALYSIS OF MICROWAVE AND WIRELINE RADAR REMOTING TECHNIQUES Final Report

John W. Drake and Robert L. Schein Mar. 1963 68 p 5 refs
(Contract ARDS-628)

The objective of this report is the comparison of the cost to the FAA of wireline remoting of digitalized radar and beacon data (and beacon only) to Air Route Traffic Control Centers with the costs for microwave remoting of the same information in analog form. The second technique includes facilities for subsequent converting of the data to digital form at the center. The costs considered are those not yet sunk or committed, i.e., future costs. Costs for both methods alone, and for a mixed system, are developed for each of two nationwide remoting networks—that presently programed including new links for which the FAA may be committed through FY 1964, and a hypothetical network to provide radar coverage to 5,000 ft. msl or 3,000 ft. above the terrain, whichever is higher. Costs are developed for each microwave repeater and terminal pair of each link, based on individual variations in terrain and hardware requirements. The investigation concludes that the difference in cost between the two transmission methods is small. Where a difference does exist it generally favors the wireline technique.
Author

N63-15835 Plesset (E. H.) Associates, Inc., Santa Monica, Calif.

UNDERGROUND EFFECTS OF NUCLEAR WEAPONS IN THE CLOSE-IN REGION Final Report, Volume I

G. F. Mc Donough, Jr. Mar. 15, 1963 200 p refs
(Contract DA-49-146-XZ-073)
(DASA-1357 (1))

A description of the underground effects of nuclear detonations in the close-in region (the area within the range to 1,000 psi surface overpressure) is presented to provide basic data for the design of protective structures. Air blast and ground shock pressures and their associated ground motions are discussed. Also, radiation effects are treated. M.P.G.

N63-15864 General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.

DERIVATION OF MAINTAINABILITY REQUIREMENTS FOR MILITARY WEAPONS SYSTEMS

T. B. Slattery Feb. 25, 1963 25 p 6 refs For presentation at Joint IAS-SAE-ASME Aerospace Reliability and Maintainability Conf., Washington, D. C., May 6-8, 1963
(Paper SP-216)

This report stresses a philosophy of approach and a method for deriving certain specific maintainability-design requirements for military weapon systems. Emphasis was placed on the importance of matching maintainability requirements to mission objectives through a connecting link of system downtime. Current specifications, by quantifying maintainability, restrict the military contractor significantly in his latitude of approach to solving the maintainability problem. N.E.A.

N63-15872 National Research Council. Committee for the IQSY—Geophysics Research Board, Washington, D.C.

PROPOSED UNITED STATES PROGRAM FOR THE INTERNATIONAL YEARS OF THE QUIET SUN 1964-65

M. A. Pomerantz Feb. 1963 56 p

The proposed United States program for the International Quiet Sun Years (IQSY) is outlined as follows: meteorology, geomagnetism, aurora, airglow, ionospheric physics and radioastronomy, sun and interplanetary medium, cosmic rays and geomagnetically trapped radiation, aeronomy, world days, and world-data center. R.C.M.

N63-15874 National Aeronautics and Space Administration, Washington, D.C.

THE 1962 LANGLEY MEMORIAL LECTURE

Raymond L. Bisplinghoff Dec. 6, 1962 12 p Repr. from Skyscraper Engineer, Jan. 1963 Third Lecture of a series held at Pittsburgh U.

A brief biographical sketch of the lives of Samuel P. Langley and Dr. Raymond L. Bisplinghoff is presented, as well as a lecture given by Dr. Bisplinghoff. The lecture covers such topics as the ion engine, the nuclear turboelectric space-power system, materials research, and communications. The role of science and engineering in aeronautics and space research is outlined. D.E.R.

N63-15976 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

FROM PEENEMUNDE TO OUTER SPACE. [A VOLUME OF PAPERS] COMMEMORATING THE FIFTIETH BIRTHDAY OF WERNHER VON BRAUN

Ernst Stuhlinger, Frederick I. Ordway III, Jerry C. Mc Call, and George C. Bucher, eds. Mar. 23, 1962 832 p 319 refs

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38. A POSSIBLE APPROACH TO SCIENTIFIC EXPLORATION OF THE PLANET MARS E. A. Steinhoff (RAND Corp.) p 803–836 23 refs (See N63-16014 13-29)
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40. EPILOGUE W. R. Dornberger (Bell Aerosystems Co.) p 851–853 1 ref

N63-16006 Servomechanisms, Inc. Research and Development Center, Goleta, Calif.

THE PROPELLANT MANAGEMENT FIELD

Helmut Zoike *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 653–683 21 refs (See N63-15976 13-01)

The development and evolution of the field of propellant management is discussed with special emphasis on the differential pressure or Δp method. The subsystems for propellant management are defined and the problems and design considerations for these subsystems are outlined. It is concluded that the Δp method fulfills the requirements of simplicity, ease of maintenance, checkout capability, and accuracy and stability. R.C.M.

N63-16015 General Electric Co., New York, N.Y.

INTERNATIONAL COOPERATION IN SPACE

Richard W. Porter *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 837–849 1 ref (See N63-15976 13-01)

The history of international cooperation in space is reviewed. Space research received its first major impetus from the International Geophysical Year (IGY) under the sponsorship of the International Council of Scientific Unions (ICSU). The IGY program was extended for another year by a subsequent program known as International Geophysical Cooperation 1959 (IGC-59). Data were accumulated, often simultaneously, on earth sciences, weather and climate, and upper atmosphere and planetary space with special emphasis on solar-terrestrial relationships. In addition to these data, the most important results of the IGY were the direct contacts established among scientists of different nations, and the establishment of World Data Centers and communications links. The Committee on Space Research (COSPAR) was designated as the IGY successor; its membership includes both IGY and ICSU representatives; and its purpose is to further scientific investigations using rockets or rocket-propelled vehicles. The International Astronautical Federation, (IAF), in existence since the 1930's, complements COSPAR, because its interest lies in the technology of space flight. The United States policy, as exemplified by the NASA program, extends international cooperation to the actual launching of scientific satellites prepared by scientists of other countries. M.P.G.

N63-16098 Southwest Research Inst., San Antonio, Tex.

INFORMATION ON DATA EXCHANGE PROGRAM—ENVANAL

R. E. Engelhardt *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III. Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 276–277 2 refs (See N63-16076 13-33)

The ENVANAL (Environment Analysis) program develops systems which summarize the extent of available data pertaining to the performance of ordnance equipment under arctic and desert conditions. The ENVANAL system gives environmental program planners a quick review of what has gone on before and also helps establish those items which require additional testing. N.E.A.

N63-16099 Quartermaster Research and Engineering Labs., Natick, Mass.

THE ARMY QUARTERMASTER CORPS PROJECTS COVERING THE ANALYSIS AND EVALUATION OF ENVIRONMENTAL FACTORS

William B. Brierly *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 278–300 22 refs (See N63-16076 13-33)

The Earth Sciences program of the Army Quartermaster Corps provides data on the natural environments which are of primary importance to design, development, testing, and storage of military equipment and materiel. Research findings of this program are presented, together with some of the problems inherent in their establishment and use. Author

N63-16103 Illinois U. Engineering Experiment Station, Urbana

A SUMMARY OF ENGINEERING RESEARCH 1962-1963

W. David Penniman, Michael B. Shelly, and Paul T. Bryant, comps. and eds. Mar. 1963 168 p refs

(*Its* Bulletin, v. 60, no. 72) Available from Engineering Publications, 112 Civil Engr. Hall, Illinois U.

Summaries of research being conducted at the Engineering Experiment Station in the following fields are presented: aeronautical and astronautical engineering; agricultural engineering; ceramic engineering; chemical engineering; civil engineering; electrical engineering; mechanical and industrial engineering; mining, metallurgy, and petroleum engineering; nuclear engineering; and theoretical and applied mechanics. M.P.G.

N63-16148 Canadian Armament Research and Development Establishment, Valcartier

STATUS REPORT ON THE REENTRY PHYSICS PROGRAM DEC. 31, 1962

Apr. 1963 66 p 5 refs

(ARPA Order 133)

(CARDE TM-740/63)

This report is a description of progress achieved up to December 31, 1962, in the present C.A.R.D.E. reentry physics program. A brief description is given of the instrumentation employed in the radiation measurements, and some of the results obtained are presented. Supporting theoretical research at C.A.R.D.E. is discussed. An appendix describes the status of hypersonic-range technology at C.A.R.D.E. as it affects the reentry physics program. Author

N63-16228 National Aeronautics and Space Administration, Washington, D.C.

TOWARD THE NEW HORIZONS OF TOMORROW

Hugh L. Dryden [1962] 16 p Von Kármán Lecture, American Rocket Society, 17th Annual Meeting, Los Angeles, Calif., Nov. 16, 1962

OTS: $1.60 ph, $0.80 mf

The present status of accomplishment of the objectives of the National Aeronautics and Space Act is reviewed, and predictions of future developments are made with full acknowledgement of the pitfalls of prophesy. Vehicle size, power, and propulsion, satellite applications, and manned spaceflight missions are discussed. Such subdivisions of the space program are becoming more arbitrary as the various phases of the program begin to coalesce; for example, the manned space station will be useful for both manned and unmanned exploration and could also be the site of weather observation or of communications relay operations. The organization of the space team is also discussed; the differences between the aims of the scientist and the engineer, the research biologist and the aerospace doctor, require tolerance, a broad point of view, and an understanding of the roles and responsibilities of each. The space team must be a disciplined one in which firm decisions are made by an appointed leadership, after a democratic hearing of all alternatives; only limited changes in decisions can be made if the desired space goals are to be reached. M.P.G.

N63-16273 Illinois U. Coordinated Science Lab., Urbana

PROGRESS REPORT FOR DECEMBER 1962-FEBRUARY 1963

D. Alpert et al Apr. 24, 1963 63 p 46 refs

(Contract DA-36-039-TR-US-AMC-02208 (E))

Progress has been reported on an electric vacuum gyroscope; the pressure shift of the hyperfine structure of atomic nitrogen in the ground state for molecular nitrogen, helium, argon, and neon buffer gases; computers; system theory; PLATO; vacuum instrumentation; plasma physics; high magnetic field superconductors; vacuum electrical breakdown; physical electronics; and arms control and disarmament research. N.E.A.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-15809 California Inst. of Tech. Graduate Aeronautical Labs., Pasadena

THE ACCURACY OF APPLYING LINEAR PISTON THEORY TO CYLINDRICAL SHELLS

Hans Krumhaar Mar. 1963 34 p 11 refs

(Supported by AFOSR)

(SM-62-50)

In this report, the aerodynamic pressure acting on a circular cylindrical shell of infinite length in an airflow parallel to the cylinder axis is studied. The shell is deformed by a harmonically oscillating standing wave of a sinusoidal pattern. Based upon the exact solutions, asymptotic expansions are developed for the aerodynamic pressure. In this manner the accuracy of the linear piston-theory approximation, when applied to cylindrical shells, is investigated. Furthermore, improved approximations can be obtained from these asymptotic expansions. Author

N63-15941 Aberdeen Proving Ground. Ballistic Research Labs., Md.

THE MAGNUS FORCE ON A FINNED BODY

Anders S. Platou Mar. 1963 22 p 13 refs

(BRL-1193)

The effect of spin on the aerodynamic forces generated on a slowly spinning finned projectile is analyzed. Experiments in the BRL wind tunnels, which substantiate the analysis, are described and presented. It is seen that the Magnus forces and moments are as large as those existing on a rapidly spinning nonfinned projectile where these forces are known to have an influence on accuracy and stability. Author

N63-16039 Tokyo U. Aeronautical Research Inst. (Japan)

BASE PRESSURE ON TWO-DIMENSIONAL BLUNT-TRAILING EDGE WINGS AT SUPERSONIC VELOCITIES

Keiichi Karashima Oct. 1961 26 p 38 refs

(*Its* Rept. 368 (Vol. 27, no. 8))

This paper gives the results of an analytical approach to the base pressure on two-dimensional blunt-trailing-edge wings at supersonic velocities, when the approaching boundary layer is laminar. Interaction between dissipative flow and neighboring nearly isentropic flow behind the flow separation at the blunt trailing edge is first analyzed and the quantitative relations concerning the viscous interaction mechanism are presented. In contrast to the exact inviscid-flow theory which gives an infinite number of possible solutions of the base pressure, it is shown that the viscous interaction mechanism permits only one solution available for the given boundary conditions. The numerical computation is carried out for free-stream Mach numbers of 1.5, 2.0, and 3.1 to obtain the base pressure on two-dimensional thin airfoil with blunt trailing edge and the results are compared with the experiment made by Chapman, Wimbrow, and Kester. Author

N63-16117 Aeronautical Systems Div. Dyna-Soar Engineering Office, Wright-Patterson AFB, Ohio

OPTIMIZATION OF LIFTING RE-ENTRY VEHICLES

Wilbur L. Hankey, Jr. (Ph. D. Thesis–Ohio State U.) Mar. 1963 86 p 29 refs

(ASD-TDR-62-1102)

In this study the lifting reentry configuration was optimized to maximize hypersonic lift-to-drag ratio (L/D) within the heating, stability, and landing constraints. A flat-bottom surface, clipped delta planform with a 0.32 taper ratio, dorsal delta fins, and elliptical (2:1) nose and leading edges were ascertained to produce maximum hypersonic L/D for the prescribed constraints. Eleven pertinent constraint equations were formulated, and numerical calculations of the complete aerodynamic characteristics and configurational geometry were determined. The IBM-7090 computer was used to solve the 11 constraint equations through an iteration technique and to perform the maximization process. Optimum configurational geometries were evaluated for three wing loadings at vehicle weights of 10,000 and 100,000 pounds. Results show that higher L/D values can be achieved with low aspect ratio, low wing loadings, and large-scale vehicles. The complete geometry for one of the typical optimums is shown as an example. Author

N63-16134 Aerospace Corp. Labs. Div., El Segundo, Calif.

AEROMECHANICS PROGRAM: NONEQUILIBRIUM PHENOMENA IN ROCKET NOZZLES Semiannual Technical Report, July 1-Dec. 31, 1961

T. A. Jacobs Mar. 9, 1962 52 p 29 refs

(Contract AF 04(647)-930)

(DCAS-TDR-62-26; TDR-930(2230-06)TR-1)

Theoretical calculations of recombination dissociation processes of homonuclear diatomic molecules have been made according to the theory of Benson and Fueno. The theory of absolute reaction rates has been pursued, employing methods devised by

Sato and Eyring for the construction of potential energy surfaces. Refinements in the experimental shock-tube facility are discussed, and the results of preliminary tests of the side-wall rapid-expansion system are illustrated. A review of theoretical and experimental considerations for a recently initiated flash-photolysis facility is presented. The performance of a catalytic surface atom concentration probe in hypersonic nonequilibrium flows has been evaluated, and the operation regimes for the probe in a glow-discharge facility defined. Author

N63-16135 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PERFORMANCE SUMMARY AND ANALYSIS OF A MACH 3.0 DESIGN AXISYMMETRIC ALL-EXTERNAL-COMPRESSION DOUBLE-CONE INLET FROM MACH NUMBER 3.0 TO 0.8

John L. Allen, Owen H. Davis, and Glenn A. Mitchell Washington, NASA, Apr. 1960 17 p 6 refs
(NASA TM-X-149) OTS: $1.60 ph, $0.80 mf (Declassified)

Previously reported data for the same inlet design are summarized and evaluated on the basis of inlet-engine matching requirements over the speed range. Reduced critical mass-flow ratios due to throat choking increased the additive drag at below-design speeds, causing the total drag to reach a peak at about Mach 1.3 of 3.4 to 3.7 times the Mach 3.0 value. When matched to a turbojet, even generously oversized inlets had a rather flat effective-thrust curve between Mach 2.4 and 1.4 because of the inherent choked-throat region for this type of inlet. A ram-scoop boundary-layer bleed improved effective thrust about 20 percent at the design point, but yielded lower values than the no-bleed inlet below Mach 2.0. Author

N63-16136 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PERFORMANCE OF A MACH NUMBER 3.0 DESIGN AXISYMMETRIC DOUBLE-CONE EXTERNAL-COMPRESSION INLET IN THE MACH NUMBER RANGE 1.97 TO 0.79

Owen H. Davis and Glenn A. Mitchell Washington, NASA, Apr. 1960 30 p 5 refs
(NASA TM-X-154) OTS: $2.60 ph, $1.10 mf (Declassified)

This study extends the Mach number range of the data on an inlet whose performance from Mach number 3.0 to 1.48 has been reported previously. Emphasis is given to defining the drag components at the detached-shock conditions. The effect of cowl projected area on additive and cowl drags is briefly examined. Also studied is the effect of translating only the first cone to reduce drag by oblique rather than bow-shock spillage. Author

N63-16137 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

A TRANSONIC WIND-TUNNEL INVESTIGATION OF THE STATIC LONGITUDINAL AND LATERAL AERODYNAMIC CHARACTERISTICS OF A PROPOSED HYPERSONIC GLIDER WITH SEVERAL BOOSTER CONFIGURATIONS

Ralph P. Bielat NASA, Washington, Dec. 1960 39 p 3 refs
(NASA TM-X-345) OTS: $3.60 ph, $1.37 mf (Declassified)

The models consisted of two booster configurations with the glider, two booster-fin configurations with the glider, and a booster-fin configuration with the glider removed and replaced with a conical nose. The tests were made at Mach numbers from 0.70 to 1.20 for angles-of-attack varying from $-6°$ to $8°$ and for angles-of-sideslip varying from $-5°$ to $5°$. Additional tests with glider elevon deflections of $0°$ and $\pm 15°$ were also made. The Reynolds number of the tests based on the glider wing mean aerodynamic chord ranged from approximately 1.08×10^6 to 1.89×10^6. Author

N63-16205 Boeing Scientific Research Labs., Seattle, Wash.

SLENDER BODIES OF REVOLUTION HAVING MINIMUM TOTAL DRAG AT HYPERSONIC SPEEDS

Angelo Miele and David G. Hull Feb. 1963 62 p 7 refs
(DI-82-0230; Flight Sciences Lab. TR-70)

This paper considers the problem of minimizing the total drag (sum of the pressure drag and the friction drag) of a slender, axisymmetric body at zero angle-of-attack in hypersonic flow. It is assumed that the distribution of pressure coefficients is Newtonian and that the friction coefficient is constant. After satisfying the condition that the pressure coefficient is nonnegative, the minimal problem is solved for arbitrary conditions imposed on the diameter, length, and the volume under the assumption that the wetted area is free. Four classes of bodies are identified: (1) bodies composed of a regular shape only, (2) bodies composed of a spike followed by a regular shape, (3) bodies composed of a regular shape followed by a cylinder, and (4) bodies composed of a spike followed by a regular shape followed by a cylinder. Particular attention is devoted to solutions for which one, two, or three of the quantities (length, diameter, and volume) under consideration are prescribed. For each of the cases considered, analytical expressions are derived for the optimum shape, the thickness ratio, and the drag coefficient. N.E.A.

N63-16259 Litton Systems, Inc., Woodland Hills, Calif.

A PRELIMINARY INVESTIGATION OF THE EFFECTS OF VARIATIONS IN REYNOLDS NUMBER AND SURFACE TEMPERATURE ON FOUR SURFACE PRESSURES ON A SLIGHTLY BLUNTED 7-1/2° HALF-ANGLE CONE AT MACH NUMBERS 5 AND 8 FOR ANGLES OF ATTACK UP TO 24° [Final Report]

Fred O. Smetana (U. Southern Calif.) Aug. 1962 34 p
(Contract AF 33(657-7715)
(ASD-TDR-62-360; AD-287452)

A preliminary investigation of the effects of variations in Reynolds number and surface temperatures on four surface pressures was conducted on a slightly blunted 71/2° half-angle cone at Mach numbers of 5 and 8 for angles-of-attack up to 24°. It was found that the variation of cone pressure with angle-of-attack followed the expected $\sin^2$ distribution and that the β plane pressure changes with angle-of-attack (α) could be predicted from the characteristics of a cylinder normal to a stream of Mach number M sin α. Results indicated that, although the cone was insensitive to changes in Mach number in the investigated Mach-number range for constant Reynolds number, a reduction in free-stream Reynolds number by an order of magnitude appeared to reduce the angle-of-attack sensitivity by about ten percent. For the range of Mach numbers tested, the displacement of the free stream by the boundary layer was small, amounting to a maximum of 1/2° increase in effective cone angle for M = 8 and Re/ft = 3×10^5 and insignificant increases for the lower Mach number and higher Reynolds numbers. For the Reynolds numbers investigated, the effect of wall temperature was also found to be small; the ratio of free-stream stagnation to wall temperature had to be greater than three to produce measurable changes in the pressure distribution from the $T_W/T_S = 1$ values. Author

N63-16289 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF BUFFET PRESSURES ON MODELS OF LARGE MANNED LAUNCH VEHICLE CONFIGURATIONS

George W. Jones, Jr., and Jerome T. Foughner, Jr. Washington, NASA, May 1963 71 p 8 refs
(NASA TN-D-1633) OTS: $1.75

Two rigid models, differing in size by a factor of 5, were tested at Mach numbers from 0.4 to 1.2. Reynolds numbers from 0.4×10^6 to 9.0×10^6 (based on second-stage diameter), and angles-of-attack from $0°$ to $\pm 4°$. Buffet problem areas on the vehicle were defined. The vehicle may have a venting problem at Mach numbers just below 1.0 and a problem in designing the structure to withstand high noise levels, but no serious structural-response problem.

An evaluation of buffet scaling relationships derived from simple dimensional considerations lends confidence to the use of suitably scaled models in determining the buffet pressure characteristics of large launch vehicles. Author

N63-16297 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE OF A PLUG NOZZLE HAVING A CONCAVE CENTRAL BASE WITH AND WITHOUT TERMINAL FAIRINGS AT TRANSONIC SPEEDS

Charles E. Mercer and Leland B. Salters, Jr. Washington, NASA, May 1963 26 p 5 refs
(NASA TN-D-1804) OTS: $0.75

The performance of a plug nozzle with concave central base, with and without terminal fairings, has been evaluated at transonic speeds. The overall efficiency decreased with increase in Mach number. The terminal fairings decreased the thrust minus drag at subsonic speeds but increased that for sonic and above-sonic speeds. The base flow pattern influenced the concave-base thrust but not the overall thrust minus drag. Author

N63-16317 Naval Ordnance Test Station, China Lake, Calif.

SUMMARY OF RESULTS OF PRESSURE COEFFICIENT CALCULATIONS FOR A SPHERICAL-TIPPED TANGENT-OGIVE BODY

Kinge Okauchi Oct. 1962 25 p 7 refs
(NAVWEPS-8048, NOTS-TP-3050)

A review of the results obtained in preliminary work conducted by the Naval Ordnance Test Station to develop procedures for the calculation of pressures on practical body shapes, using currently available theories and computing methods, is presented. A comparison of the calculated results with experimental data is made to check the validity of the procedures. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-15771 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF A FULL-SCALE PROPELLER TESTED WITH BOTH RIGID AND FLAPPING BLADES AND WITH CYCLE PITCH CONTROL

Kenneth W. Mort and Paul F. Yaggy Washington, NASA, May 1963 34 p 3 refs
(NASA TN-D-1774) OTS: $1.00

Basic aerodynamic characteristics of the two propeller configurations are presented for free-stream velocities ranging from 0 to 140 knots and for angles-of-attack ranging from 0° to 70°. The differences in the characteristics of the two configurations were small. The effect of the cyclic pitch control on the aerodynamic characteristics and on the blade flapwise bending and trailing-edge tensile stress was examined at free-stream velocities ranging from 0 to 60 knots. The cyclic pitch control was about a single control axis, intended only to produce longitudinal trim and control. At hover conditions, the cyclic-control effectiveness of the rigid configuration was about twice that of the flapping configuration. By extrapolating the test results to conditions of maximum allowable blade stress, it was estimated that the maximum longitudinal-control capability, as limited by the allowable blade stresses, was greater for the rigid configuration than for the flapping configuration. Author

N63-15922 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LARGE-SCALE WIND-TUNNEL TESTS IN GROUND EFFECT OF A 35° SWEPTBACK WING JET TRANSPORT MODEL EQUIPPED WITH BLOWING BOUNDARY-LAYER-CONTROL TRAILING- AND LEADING-EDGE FLAPS

Kiyoshi Aoyagi and David H. Hickey Washington, NASA, May 1963 54 p 3 refs
(NASA TN-D-1884)

Two chordwise and spanwise extents of trailing-edge flaps, with and without blowing boundary-layer control, were tested with the normal wing leading edge. A limited amount of data was obtained with the blowing boundary-layer-control leading-edge flap. Three-component longitudinal data and boundary-layer-control flow requirements are presented for several heights above ground. Also presented are data showing the effects of ground proximity on the trimmed-lift coefficient of the model and on the calculated thrust-to-weight ratio required to maintain low-speed level flight with several trailing-edge flap configurations. Author

N63-16130 Vidya, Inc., Palo Alto, Calif.

THEORETICAL INVESTIGATION OF DYNAMIC STABILITY DERIVATIVES OF DUCTED PROPELLERS

A. R. Kriebel, A. H. Sacks, and J. N. Nielsen Jan. 9, 1963 214 p 22 refs
(Contract NOw-62-0129-C)
(Vidya Rept. 63-95)

The static and dynamic stability derivatives of a ducted propeller are predicted by theoretical analysis. The analysis is applied to the case of a torpedo-like configuration consisting of a body-of-revolution with a rear-mounted ducted propeller in axial flow. The natural frequency and damping of the configuration is calculated, and the individual contributions of the duct, the propeller, the hull, and a fin (added for static stability) are determined. It is found that the ducted propeller is a more effective oscillation damper than is a fin of the same projected area and that the effectiveness increases with propeller disk loading. The contribution of the ducted propeller to the dynamic stability of the torpedo is found to be dominated by the static stability derivative of the isolated ducted propeller. Author

N63-16139 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

THE EFFECT OF AIR BLEED ON THE HEAT TRANSFER AND PRESSURE DISTRIBUTION ON 30° CONICAL FLARES AT A MACH NUMBER OF 6.8

Davis H. Crawford Washington, NASA, Mar. 1961 48 p 29 refs
(NASA TN-X-439) OTS: $4.60 ph, $1.64 mf (Declassified)

The effect of a boundary-layer bleed at the start of a 30° half-angle flare upon the shape of the flow boundaries, the pressure distribution on the flare, and the heat transfer to the flare was studied at a Mach number of 6.8. The forebody was an ogive cylinder. Test Reynolds numbers, based on forebody length, ranged from 1×10^6 to 7.4×10^6. Schlieren photographs showed the effect produced on the flow boundaries by varying the dimensions of the bleed in both the radial and axial directions and by blunting the lip at the leading edge of the flare. The heat transfer and pressure distribution on the flare were correlated with the shape and nature of the flow boundaries. Author

N63-16160 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

QUALITATIVE EVALUATION OF EFFECT OF HELICOPTER ROTOR-BLADE TIP VORTEX ON BLADE AIRLOADS

James Scheiman and LeRoy H. Ludi Washington, NASA, May 1963 47 p 8 refs
(NASA TN-D-1637) OTS: $1.25

A flight-test program was conducted to determine helicopter rotor-blade airloads by means of 49 pressure transducers in the

blade. Two flight conditions are examined in detail. Important differences between the measured results and the results from uniform inflow theory are shown to be attributable to the blade trailing (tip) vortices. The vibratory blade loading is shown to be significantly influenced by the trailing vortex of the preceding blades. This influence produces harmonic blade loadings of all orders, and the percentage of the contribution to the higher harmonics is large. Author

N63-16166 Aeronautical Research Council (Gt. Brit.)

A THEORETICAL INVESTIGATION OF THE EFFECT OF CHANGE IN AXIAL VELOCITY ON THE POTENTIAL FLOW THROUGH A CASCADE OF AEROFOILS

D. Pollard and J. H. Horlock (Liverpool U.) London, HMSO, 1963 14 p 3 refs

(ARC-CP-619; Supersedes ARC-23815) Available from HMSO: 2s 6d

An analysis is given in which the method of singularities, used for the determination of cascade performance, is modified to account for a change in axial velocity across the cascade. Changes in axial velocity across blade rows occur frequently in turbomachines and solid-wall wind-tunnel cascade tests. Author

N63-16185 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF AERODYNAMIC HEATING ON THE FLUTTER OF THIN FLAT-PLATE ARROW WINGS

Joseph M. Groen and Richard Rosecrans Washington, NASA, May 1963 24 p 8 refs

(NASA TN-D-1788) OTS: $0.75

From the results of tests made in a heated wind tunnel at Mach 3, an experimental flutter boundary was obtained which showed the effect of aerodynamic heating. Induced thermal stress resulted in a loss of wing stiffness which lowered the flutter-velocity index by as much as one-third. The flutter boundary obtained also indicated the transient nature of the phenomenon. Test results are compared with calculated values of temperature and with natural frequencies of vibration and associated nodal patterns. Measured flutter points are compared with a calculated flutter boundary for an unheated wing. Author

N63-16237 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, Va.

AERODYNAMICS OF OSCILLATING CONTROL SURFACES AT TRANSONIC SPEEDS

Robert F. Thompson and Sherman A. Clevenson Washington, NACA, June 17, 1957 19 p 16 refs

(NACA-RM-L57D22b) OTS: $1.60 ph, $0.80 mf (Declassified)

Oscillating flap-type and all-movable controls are discussed with particular emphasis on the aerodynamic forces and moments at transonic speeds. Hinge-moment results from recent wind-tunnel and rocket-powered-model tests are summarized for trailing-edge flap-type controls to illustrate the effects of control hinge-line position and profile shape on one-degree-of-freedom flutter of this type of control. From a wind-tunnel investigation of a model considered representative of an all-movable control, the aerodynamic effects due to rigid-body-oscillation modes in roll and in pitch are presented. The general magnitudes of the unstable aerodynamic damping moments for the flap-type controls are presented. No significant benefits toward alleviating the unstable aerodynamic damping in the control rotational mode at transonic speeds were obtained for a wide range of hinge-line positions tested. Of three control profile modifications tested, only a "wedge" modification to a 35-percent-overhang balanced control gave significant improvements in "buzz" stability. This wedge control gave stable aerodynamic damping in the control rotational mode up to the maximum speed tested. However, the stable damping and improvement in flutter characteristics were limited to oscillation amplitudes less than about 3°. For an all-movable control, the oscillating aerodynamic derivatives which define the separate effects of rigid-body pitch and rigid-body roll have been presented through the transonic speed range. The aerodynamic damping for this low-aspect-ratio all-movable control was stable at all conditions tested. Author

N63-16288 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE THEORY OF INDUCED LIFT AND MINIMUM INDUCED DRAG OF NONPLANAR LIFTING SYSTEMS

Clarence D. Cone, Jr. Washington, NASA, 1962 34 p 7 refs

(NASA TR-R-139) GPO: $0.40

The basic theory of the induced lift and drag of nonplanar, circulation lifting systems is developed, and methods are evolved for determining the span force loading intensity necessary for minimum induced drag. It is shown that the aerodynamic efficiency of such optimally loaded systems can be expressed in terms of an effective aspect ratio which depends in value upon the spatial distribution of the vorticity of the system. Methods for determining the maximum effective aspect ratio of arbitrary lifting systems of given span by use of conformal transformation and electrical potential-flow analog techniques are developed and illustrated. The value of the induced-drag efficiency factor is determined for the families of circular, semiellipse, and complete-ellipse arcs and for several more complex forms. The results of the theory are interpreted in terms of the physical airfoil requirements necessary for successful realization of the theoretical induced-drag reductions. The practical application aspects of nonplanar wing systems are briefly considered. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-15774 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MANEUVER ACCELERATIONS EXPERIENCED DURING ROUTINE OPERATIONS OF A COMMERCIAL TURBOJET TRANSPORT AIRPLANE

Paul A. Hunter and Mary W. Fetner Washington, NASA, May 1963 8 p 4 refs

(NASA TN-D-1801) OTS: $0.50

The incremental maneuver normal accelerations collected during both passenger-carrying operational flights and check and training flights of a four-engine turbojet commercial-transport airplane have been evaluated. The frequency of occurrence of maneuver accelerations per mile of flight for climb was approximately the same as that for descent. The frequency of occurrence for each of these two flight conditions was about ten times that during cruise. This tendency is typical of transport operations, particularly for the turbojet transports. Author

N63-15833 Aeronautical Research Council (Gt. Brit.)

THE STABILITY OF AN AIRCRAFT UNDER AUTOMATIC THROTTLE CONTROL AND THE CROSS-COUPLING EFFECTS WITH ELEVATOR CONTROL

D. E. Fry and M. R. Watts London, HMSO, Oct. 1958 23 p 4 refs

(ARC-R&M-3314; Supersedes RAE-TN-IAP-1079; ARC-21040) Available from HMSO: 9s

The stability of an aircraft with automatic throttle and elevator controls has been investigated theoretically using an analog computer. Throttle application, proportional to change in airspeed, incidence, or rate of pitch, may provide damping of the long-period

motion, but speed is shown to be the most suitable variable. The control of an aircraft having negative static margin is considered, and shown to require either the addition of an integral control on the throttle or a combination of throttle and elevator controls. Where it is required to control height by means of the elevator, some aircraft flying under certain conditions can only be adequately stabilized by means of an automatic throttle control. Author

N63-15901 International Civil Aviation Organization, Montreal (Canada)

AIRWORTHINESS COMMITTEE, FIFTH MEETING, MONTREAL, 21 MAY-16 JUNE 1962

[1962] 272 p

(Doc. 8283-AN/878) Available from ICAO, Intern. Aviation Bldg., 1080 Univ. St., Montreal, (Canada): $2.00

Action taken on the following agenda is reported: (1) revision of the provisional means of compliance on airplane performance; (2) flight (operational monitoring of take-off performance, flying qualities); (3) static pressure system error; (4) location and size of aircraft nationality and registration marks; and (5) a review of the work program. I.v.L.

N63-15946 Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge

SONIC BOOM STUDIES

Manfred P. Friedman Feb. 1962 73 p 18 refs

(MIT-AL-TR-29)

Results of studies on various aspects of the sonic-boom problem are given in the present report. The major contribution is a means of describing a shock propagating through a nonuniform atmosphere. Variations in ambient pressure, sound speed, and crosswinds can be treated. By using the techniques developed herein, it is possible to determine the position as well as the strength of a shock, induced by a supersonic aircraft, at any distance from the aircraft. Considered also is the shock pattern of an accelerating supersonic aircraft. Other problems discussed are the shock pattern on the ground of a diving or accelerating aircraft, the significance of assumptions such as isothermal or isentropic atmosphere, and relation between acoustic propagation and shock propagation. Author

N63-15962 Deutsche Forschungsanstalt für Luftfahrt. Inst. für Aerodynamik, Brunswick (W. Germany)

[AERODYNAMIC PROBLEMS OF SHORT TAKE-OFF AND LANDING AIRCRAFT. (V/STOL AIRCRAFT)] AERODYNAMISCHE PROBLEME DER FLUGZEUGE MIT KURZER START- UND LANDESTRECKE (V/STOL-FLUGZEUGE)

H. Schlichting and A. Das Sept. 27, 1961 35 p 22 refs Dedication address for the DFL Standard Wind Tunnel, Oct. 27, 1961 In GERMAN

(Rept. 61/24; DFL-167)

This dedication address for the standard wind tunnel of the German Aeronautical Research Institute at Braunschweig covers the research problems that can be investigated with such a tunnel. (The tunnel has a cross sectional area of 3.6 m × 2.8 m^2, a maximum speed of 65 m/s, and a power output of 800 kw.) These problems are mainly concerned with the aerodynamic problems of takeoff and landing for both jet aircraft and aircraft with extremely short takeoff and landing (VSTOL aircraft). Various methods for shortening the takeoff and landing are discussed, such as influencing the boundary layer with leading-edge flaps, slats, blowout, and suction; slip-stream deflection by means of flaps; and propulsion-jet deflection by tilting the entire propulsion unit as well as the airplane wings. A survey is also presented of research work of the Institute of Aerodynamics, German Aeronautical Research Institute, on maximum lift. This work covers the influence of blowout on the boundary layer by airplane wings with jet flaps, and ground effects in the case of airplane wings with blowouts. I.v.L.

N63-16104 Air Force Dept. Directorate of Development Planning, Washington, D.C.

THE SONIC BOOM PROBLEM Development Planning Memo

Mar. 1963 32 p 9 refs

The current state of knowledge on sonic boom generation, propagation, and effects, and attempts to judge the severity of the problem that will arise with the beginning of commercial supersonic flights are summarized. The report covers the following: (1) physical characteristics of sonic booms, (2) lift and volume components, (3) overpressures, (4) configurations, (5) Anglo-French design, (6) penalties of supersonic flight, and (7) prospects for the future. N.E.A.

N63-16119 Northrop Corp. Norair Div., Hawthorne, Calif.

METHODS OF ANALYSIS AND SYNTHESIS OF PILOTED AIRCRAFT FLIGHT CONTROL SYSTEMS

D. T. Mc Ruer et al Mar. 1952 234 p 4 refs

(Contract NOas 51-514(c))

(AE-61-4-I)

The analysis and synthesis of piloted aircraft control systems are discussed. Included are optimum synthesis methods and systems analysis methods. Machine methods, nonlinearities, and the analog computer are also discussed. The basic approach to control systems problems are through the transfer function. The various ways of dealing with such problems in practice are essentially means of getting various degrees of approximations to the transient solution of the equations of motion from which the transfer functions are derived. Since the object of prime interest in control and servomechanisms work is the transient behavior of the system under consideration, it is felt that this approach will provide the control system engineer with a relatively new codifying concept with which to attack his problem. N.E.A.

N63-16138 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECTS OF WING PLAN FORM ON THE STATIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A FLAT-TOP HYPERSONIC AIRCRAFT AT MACH NUMBERS FROM 0.6 TO 1.4

Stuart L. Treon Washington, NASA, Apr. 1960 32 p 14 refs

(NASA TM-X-364) OTS: $3.60 ph, $1.16 mf (Declassified)

Wind-tunnel results are presented for angles-of-attack from about −7° to +23° for three models which consisted of variations of arrow-planform wings mounted atop a slender half-cone body. Reynolds number for the investigation was either 1.75 million or 2.5 million, based on the body length. Author

N63-16140 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

STABILITY AND CONTROL CHARACTERISTICS AT A MACH NUMBER OF 2.01 OF A SUPERSONIC VTOL AIRPLANE MODEL HAVING A BROAD FUSELAGE AND SMALL DELTA WINGS

Cornelius Driver and M. Leroy Spearman Washington, NASA, Feb. 1961 28 p

(NASA TM-X-441) OTS: $2.60 ph, $1.04 mf (Declassified)

Tests were made of the complete configuration as well as of various combinations of model components for combined angles-of-attack and angles-of-sideslip up to about 16°. The effects of wing camber and of deflecting the elevator and rudder were also investigated. Author

N63-16169 Aeronautical Research Council (Gt. Brit.)

SURFACE PRESSURES AND STRUCTURAL STRAINS RESULTING FROM FLUCTUATIONS IN THE TURBULENT BOUNDARY LAYER OF A FAIREY DELTA 2 AIRCRAFT

D. R. B. Webb, A. R. Keeler, and G. R. Allen London, HMSO, 1963 30 p 3 refs

(ARC-CP-638; Supersedes RAE-TN-STRUCT-313; ARC-24156)
Available from HMSO: 5s

This paper describes measurements of surface pressure and structural strain due to fluctuations in the turbulent boundary layer of a Fairey Delta 2 aircraft. The measurements were made on the lower surface of the wing at Mach numbers up to 1.6. The results show that both pressure and strain depend on the kinetic pressure q and are independent of Mach number. It is deduced that the levels of strain due to the pressure fluctuations on the surface of a proposed supersonic transport aircraft would be higher than those obtaining on existing aircraft. Author

N63-16206 Aberdeen Proving Ground. Ballistic Research Labs., Md.

A SECOND TEST OF AN UPPER ATMOSPHERE GUN PROBE SYSTEM

Spence T. Marks and Eugene D. Boyer Apr. 1963 34 p 13 refs
(BRL-MR-1464)

The second phase of a high-altitude gun-probe project is presented. The project objectives, the design considerations, the proof tests, the vertical tests, and the dispersion of the system are discussed. An altitude capability of at least 240,000 ft. and an impact-circle requirement of one-mile radius has been demonstrated in two series of firings on the Edgewood peninsula of the Aberdeen Proving Ground. Although the performance of this fin-stabilized, five-inch projectile has been proved, the tests indicate the need for further development of data packages and fuzes. Author

N63-16274 Kittel-Lacy, Inc., El Monte, Calif.

INFLEUNCE OF NOISE CONTROL COMPONENTS AND STRUCTURES ON TURBOJET ENGINE TESTING AND AIRCRAFT GROUND OPERATION [Final Report, 1958-1959]

Bonard E. Morse et al Wright-Patterson AFB, Ohio, Biomedical Lab., Dec. 1962 104 p 7 refs
(Contract AF 33(616)-5789)
(AMRL-TDR-62-134) OTS: $2.50

There has been a need for summarizing and establishing adequate aerodynamic and thermodynamic design criteria for turbojet-engine test cells and ground run-up suppressors. These criteria are discussed, and their uses are illustrated by examples of typical design-problem solutions. The presence of noise-suppression structures can have significant influences upon the operation of the turbojet engine. These influences are enumerated and evaluated with recommendations for establishing maximum acceptable effects. Typical test-cell configurations are presented, and design criteria are established for providing noise-suppression facilities which may be utilized for testing a full-size aircraft or an engine by itself. These facilities can be either permanent structures or portable units. Author

N63-16301 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Flugmechanik, Brunswick (W. Germany)

INVESTIGATIONS ON THE DYNAMIC STABILITY OF PERSONNEL GUIDE SURFACE PARACHUTES

R. Ludwig and W. Heins Mar. 14, 1963 28 p 9 refs Presented at the AGARD Flight Mechanics Panel Meeting, Torino, Italy, Apr. 16–19, 1963
(DFL-203) DFL: DM 7.50

In order to investigate the dynamic stability of a parachute, the system of the nonlinear equations-of-motion is derived. This system of differential equations is not linearized, but is integrated by means of electronic computers for a number of examples of personnel guide surface parachutes. The influence of the suspension-line length, the effective porosity of the canopy, the weight of the load and the apparent mass on the dynamic behavior are studied for the chosen examples. The results show that the oscillations of parachutes cannot be described by linearized equations-of-motion. For instance, only the nonlinear procedure enables the complete description of the velocity oscillations. Furthermore, it becomes evident that frequency and damping depend on amplitude. For some amplitudes, the square of the oscillation period is proportional to the length of the suspension lines. With increasing porosity of the canopy, the damping increases and the oscillation period decreases. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-15803 Michigan U. Radiation Lab., Ann Arbor, Mich.

THE ELECTROMAGNETIC PARAMETERS OF SELECTED TERRESTRIAL AND EXTRATERRESTRIAL ROCKS AND GLASSES

W. E. Fensler, K. M. Siegel, E. F. Knott, and A. Olte [1961] Repr. from The Moon (New York, Academic Press), Proc. of 14th Symp. of Intern. Astron. Union, Pulkovo Obs., Leningrad, Dec. 1960 p 545–565 11 refs
(NASA Grant NsG-4-59)

A program was instigated in which the electromagnetic constants of solid materials of reasonable volumes were measured and then these solids were broken up into smaller and smaller pieces and the dielectric constants of each mixture were measured. The purpose of this program was to see how closely the electromagnetic constants and the forms of these materials would approach those predicted from electromagnetic measurements of the moon. Results indicate that: (1) Meteorites, tektites, glasses, and rocks found on earth did not have electromagnetic properties that are similar to the materials found on the outer layer of the surface of the moon. (2) However, by crushing materials to particle sizes which are in the regions indicated by optical, infrared, and passive microwave data, electromagnetic constants were obtained that approach those values obtained by electromagnetic diagnostics of the lunar surface. (3) An unexpected nonlinear property of the electromagnetic conductivity for certain stony meteorites was detected. I.v.L.

N63-16195 Kyoto U. Inst. of Astrophysics (Japan)

NON-COHERENT SCATTERING IN A SEMI-INFINITE INHOMOGENEOUS ATMOSPHERE

Akira Uesugi 1962 8 p 11 refs
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 110)

In this paper, with the aid of the "combined operations" method due to Miss Busbridge, the integral equation for the scattering function in a semi-infinite, inhomogeneous, plane-parallel and non-coherently scattering atmosphere is obtained for monodirectional illumination of the surface. The diffusely reflected light from a nonemitting atmosphere is expressed in terms of the scattering function when the surface is subject to known incident radiation. Author

N63-16196 Kyoto U. Inst. of Astrophysics (Japan)

NON-COHERENT SCATTERING FOR BLENDED LINES

Akira Uesugi 1962 7 p 15 refs
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 112)

In this paper, with the aid of the modified Ambarzumian technique, the integral equation for the scattering function for the blended lines in a semi-infinite, plane-parallel and noncoherently scattering atmosphere is obtained. When only one line is concerned, the equation reduces to the ordinary expression for noncoherent scattering. Author

N63-16197 Kyoto U. Inst. of Astrophysics (Japan)
NOTE ON THE RESOLVENT OF THE AUXILIARY EQUATION FOR NON-COHERENT SCATTERING
Akira Uesugi 1962 3 p 2 refs
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 114)

In this note, a functional equation for solving the auxiliary equation in the noncoherent scattering process is given. Author

N63-16199 Kyoto U. Inst. of Astrophysics (Japan)
OPTICAL THICKNESS OF THE PLANETARY NEBULAE AND TEMPERATURE OF THE CENTRAL STARS
Toshifumi Saigusa 1962 23 p 44 refs Repr. from Mem. Coll. Sci., Univ. Kyoto, Ser. A, v. 30, no. 2, article 3, 1962 p 137–155
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 116)

Physical discussions on optical thickness of the planetary nebulae and temperature of the central stars are given on the basis of various data obtained by both the present author and other workers. As a first step, several methods of temperature determination were examined, and then the dependency of the optical thickness of the planetary nebula on its temperature, dimension, and dilution factor for the ultraviolet radiation has been studied. Using the result obtained, a more satisfactory model of such nebulae is proposed. Further, it may be suggested that future lines of study should be concentrated on the following points: (1) The deviation of the stellar radiation from the Planckian energy distribution should be estimated. (2) In the calculation of temperature the dilution factor for the continuum should be taken into account. (3) It is necessary to clarify the cause of the burst of the nova. (4) The intensity ratio of He II 4686 to O III 3133 should be examined in more detail. Author

N63-16200 Kyoto U. Inst. of Astrophysics (Japan)
ON THE ATMOSPHERE OF THE LATE-TYPE COMPONENT OF ZETA AURIGAE-TYPE STARS
Shusaku Kawabata 1962 40 p 19 refs Repr. from Mem. Coll. Sci., Univ. Kyoto, Ser. A, v. 30, no. 2, article 6, 1962 p 205-244
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 118)

Atmospheres of late-type supergiant component of Zeta Aurigae-type stars are discussed, especially with respect to the state of ionization and to the condensed structure. After deriving the ionization formulae for metallic elements in a locally condensed atmosphere, the reciprocal of the packing fraction of condensation, α, is shown to have very high values and to increase toward the upper layer of the atmosphere in order to satisfy the observed values of degree of metallic ionization, even though the ratio of the number of atoms contained in condensed region to that of smoothed case, β, is nearly equal to unity. To avoid these difficulties, high electron temperature of the atmosphere is assumed, and the ionization formula is extended by taking account of the effects of electron collision due to the high electron temperature. Temperature distribution of the atmosphere that can explain the observed degree of ionization is given with constant α as parameter for Zeta Aurigae and 31 Cygni. Results show that in the lower layer of the atmosphere $T_\epsilon = 4000° K \sim 8000° K$ for both stars and in the upper layer $T_\epsilon = 12000° \sim 16000° K$ for Zeta Aurigae and $T_\epsilon = 10000° \sim 12000° K$ for 31 Cygni, and that $\log \alpha = 2.5 \sim 5$ for both stars. It is shown that at least for 31 Cygni, those condensations cannot be directly identified as prominence-like clouds detected in the outer layer of the primary. Author

N63-16222 Leiden U. Observatory (Netherlands)
THE VARIABLE STARS IN THE SCUTUM CLOUD
Margaret Harwood 1962 80 p
(*Its* Ann. Van De Sterrewacht Te Leiden, Deel 21, Achtste Stuk)

This paper contains a study of 65 known and of 354 newly discovered variable stars in a region in or near the constellation Scutum. The variables were investigated on plates of the Maria Mitchell Observatory and on plates of the Harvard College Observatory and Leiden Observatory collections. Author

N63-16229 Space Technology Labs., Inc., Redondo Beach, Calif.
COMET INTERCEPT STUDY Final Report
Mar. 28, 1963 250 p 61 refs
(NASA Contract NASw-414)
(Rept. No. 8668-6002-RU-000)

The feasibility of a comet intercept mission in the near future is established. Such a mission is important because comets are the only source of information about the very remote regions of the solar sphere of influence. Therefore, the possibility of probing a comet for on-the-spot measurement of the complex physical processes resulting from the interaction of cometary matter with solar corpuscular and electromagnetic radiation and with the interplanetary magnetic field is of interest. Thirty-one comets were evaluated as intercept targets with regard to injection energies required at suitable launch periods, the distance of the earth at intercept, the transit and flight times, and the guidance requirements. Possible scientific instruments for measuring cometary characteristics were studied. The Atlas-Agena booster with a solid propellant third stage was found to be adequate for launching a satisfactory cometary probe. The probe would be a simple, spin-stabilized, solar-powered spacecraft with a fan beam antenna. The single problem remaining appears to be the accurate determination of the orbit of the comet, but modern photographic reference techniques, applied to comet positioning, could solve this problem without undue cost or labor. M.P.G.

N63-16232 Israel Program for Scientific Translations, Ltd., Jerusalem
PHYSICAL PROCESSES IN STELLAR INTERIORS
D. A. Frank-Kamenetskii 1962 Transl. of book "Fizicheskie protsessy vnutri zvezd", Gos. izd. fiz.-mat. lit., Moscow, 1959
(Published for NASA and NSF)
(NASA TT F-124) OTS: $3.50

Stationary and nonstationary processes in stellar interiors are covered. Topics discussed include: survey of observational data, elementary theory, construction and properties of homogeneous stellar models, heterogeneous stellar models and the corrected boundary condition, macroscopic theory of energy transfer, microscopic theory of energy transfer, processes of energy generation, beta processes and the proton reaction, hydrogen stars and hydrogen curves, models of the sun, homologous adiabatic changes in stellar states, stellar pulsations, stellar evolution, and formation of chemical elements in stars. J.A.J.

N63-16245 Harvard Coll. Observatory, Cambridge, Mass.
INSTRUMENTATION FOR OBSERVATIONS OF PLANETS IN THE FAR INFRARED
Hector C. Ingrao and Donald H. Menzel Repr. from Mem. Soc. R. Sc. Liège, 5th ser., v. 7, no. 1 [1963] p 224–240 8 refs
(NASA Grant NsG-64-60)
(*Its* Reprint 612)

The electronics to achieve detector noise operation and to measure the detector parameters are being improved. Ferroelectric bolometers are being prepared and radiation pyrometers are being constructed in order to obtain thermal scanning of the moon. J.A.J.

N63-16246 Harvard Coll. Observatory, Cambridge, Mass.
A NEW PROGRAM OF PLANETARY PHOTOGRAPHY
D. H. Menzel [1963] 1 p Repr. from Mem. Soc. R. Sc. Liège, 5th ser., v. 7, 1963 p 115 Presented at the 11th Intern. Astrophysical Symp., Liège, July 9–12, 1962
(NASA Grant NsG-89-60)
(*Its* Reprint 616)

Harvard College Observatory, under NASA sponsorship, has initiated a three-year program for multicolor photometry of the Moon, Mars, Venus, and other planets. The studies are being

undertaken with a new 16-inch Cassegrain reflector at Boyden Observatory in South Africa and with the 12-inch reflector at the Le Houga Observatory in Southern France. Three dozen comparison stars have been selected: some are of zero-color index, some of index +1, and others are of the solar type. A special lens gives an image of the Moon on a scale roughly matching that of the planets. J.A.J.

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-15770 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYTICAL STUDY OF TURBINE-GEOMETRY CHARACTERISTICS FOR ALKALI-METAL TURBOELECTRIC SPACE POWER SYSTEMS

Arthur J. Glassman and S. M. Futral Washington, NASA, May 1963 31 p 7 refs

(NASA TN D-1710) OTS: $0.75

This investigation was made primarily to determine the general effects of turbine-inlet temperature and working fluid on such turbine-geometry characteristics as number of stages, diameter, and rotative speed for a turboelectric space-power system producing 1 megawatt of electric power. The analysis showed that turbine-inlet temperature and working fluid exert significant effects on turbine geometry. Smaller diameter turbines that require an increasing number of stages were obtained by increasing turbine-inlet temperature. The required number of stages increased with decreasing working-fluid molecular weight. For any given temperature, turbine-stage diameters for cesium, rubidium, and potassium were nearly equal, but were considerably larger for sodium. Rotative speed, for any given number of stages, increased with temperature. Use of materials with higher ratios of strength to density, and use of increasing rather than constant diameters from the first to the last stage resulted in significantly fewer stages. Author

N63-15995 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

GUIDANCE AND CONTROL SYSTEMS FOR SPACE CARRIER VEHICLES

W. Haeussermann, G. G. Gassaway, and F. B. Moore *In its* From Pennemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 413–436 3 refs (See N63-15976 13-01)

The design aspects of the guidance and control systems of large carrier vehicles are given; the C-4 or C-5 configurations of the Saturn vehicles are used as illustrations of the system engineering. It is concluded that the guidance and control systems for large future space carriers will evolve through a gradual improvement of ballistic-missile inertial systems. D.E.R.

N63-16005 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ELECTRICAL SYSTEMS IN MISSILES AND SPACE VEHICLES

H. J. Fichtner *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 641–652 (See N63-15976 13-01)

The history and present state-of-the-art of electrical systems in missiles and space vehicles are reviewed. The areas covered include the V2 program, project Mercury, and Saturn program. The following subsystems are outlined: electrical power, pressurization, engine start and cutoff, flight sequencing, control, inflight cooling, heating, tracking, and telemetering. Future automation requirements for electrical systems are outlined. R.C.M.

N63-16064 General Electric Co. Missile and Space Vehicle Dept., Philadelphia, Pa.

CAVITY VAPOR GENERATOR PROGRAM [Final Report, JUNE 1961-SEPT. 1962]

D. L. Purdy, R. C. Keyser, F. A. Blake, and J. F. Williams Wright-Patterson AFB, Ohio, Flight Accessories Lab., Dec. 1962 146 p 6 refs

(Contract AF 33(616)-8394)

(ASD-TDR-62-899)

A description of the theoretical study, design, and test of a thermionic generator, utilizing solar energy concentrated by means of a parabolic collector is given. The generator produced 21.25 watts at a cathode temperature of 1773° K in solar test with a five-foot-diameter, sixty-degree-rim-angle, parabolic collector. Author

N63-16108 Thompson Ramo Wooldridge, Inc. TAPCO Div., Cleveland, Ohio

ADVANCED SOLAR THERMIONIC POWER SYSTEMS [Final Report, June 1960–Aug. 1962]

Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Dec. 1962 250 p

(Contract AF 33(616)-7411)

(ER-5038; ASD-TDR-62-877)

This report contains a state-of-the-art survey of all components required for solar thermionic power systems in the 1 to 10 kw range suitable for application in aerospace vehicles. The results of the survey and development program were used in a comprehensive parametric study to determine design criteria applicable to these systems. The development program included evaluation of thermionic converters of the vacuum and vapor type. The details of the design, fabrication, performance tests, and evaluation of thermionic converters and generators built during the program are presented. The appendix presents a detailed design, performance, and test specification for a 1.5-kw, 28-volt solar thermionic power system. Author

N63-16111 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

AN ELECTROSTATIC GENERATOR

N. G. Drozdov, A. I. Kukarin, and B. S. Savashkevich Mar. 7, 1962 10 p 3 refs Transl. from Elektrichestvo (Moscow), no. 4, 1961 p 48–50

(FTD-TT-62-35-1+2+4)

Characteristics of an electrostatic generator, utilizing electrical charges from successive dielectrics such as plexiglas, polyethylene, and teflon, are described. The generator consists of two basic parts: the stator, made of plexiglas and teflon; and the rotor, a plexiglas cylinder with metal plates inside the stator. Charges are excited on the inner surface of the stator by means of polyethylene-film brushes attached to the rotor. The electric field of the stator induces charges of the opposite sign on the plates. As the plates approach the current collectors, the free charges flow off and the bound charges remain and enter the sphere of influence of the other dielectrics. These bound charges become somewhat like additional free charges in that they intensify the basic free charge of the rotor. When dielectrics, such as teflon, plexiglas, and polyethylene, are used in generators they work faultlessly under severe climatic conditions, with humidity reaching 98 percent and temperatures from −40° C to +50° C. Also, a.c. and d.c. electrostatic generators can be designed by using such principles. N.E.A.

N63-16114 Monsanto Research Corp., Everett, Mass.
COMPACT POWER FUEL CELL [Final Report, Dec. 10, 1960–Dec. 9, 1961]
John O. Smith, Ralph G. Gentile, Frank B. Leitz, Wilson H. Power, Dominick A. Sama, and Anthony F. Wilde Wright-Patterson AFB, Ohio, Flight Accessories Lab., June 1962 88 p 7 refs
(Contract AF 33(616)-7735)
(ASD-TDR-62-42)

A fuel-cell battery was built which generates 15 watts at 5 amperes for 8 hours, utilizing hydrazine (5M in 10M KOH) as fuel and nitric acid (10M) as oxidant. The battery consisted of 3 cells, each having an electrode area of 120 cm^2. The open-circuit voltage was 5.95 volts. Over the 8-hour period, the total current was just over 5 amperes at an operating voltage of about 4 volts. The battery produced 35 watt-hours/pound. Pentaborane and hydrogen peroxide were also tested as fuel and oxidant, respectively, with each other and with hydrazine and nitric acid. Author

N63-16219 Westinghouse Electric Corp., Lima, Ohio
SPACE ELECTRIC POWER SYSTEMS STUDY First Quarterly Progress Report, Nov. 8, 1961–Feb. 8, 1962
F. C. Stump et al [1962] 312 p 6 refs
(NASA Contract Nas5-1234)
OTS: $19.75 ph, $9.56 mf

Data on the generation, control, conversion, and transmission of electric power for space vehicles are analyzed. The prototype power system being considered is rated between one and ten megawatts, voltage levels for the system are between 5000 and 50,000 volts d.c., and the coolant temperature for the generator is between 500° F and 1500° F. The only potential problems uncovered during analysis of the data are the unavailability of high-temperature magnetic materials for the generator and high-temperature components for use in the electrical control and conversion systems. M.P.G.

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-15808 Technische Hochschule, München (W. Germany)
STUDIES OF HYDROGEN AND OXYGEN EVOLUTION AND THE INFLUENCE OF ABSORBED SUBSTANCES [Final Report, Mar. 1, 1961–Feb. 28, 1962]
L. Kandler, H. Bickl, H. Feigl, and E. Hausler Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 58 p 38 refs
(Contract AF 61(052)-305)
(ASD-TDR-62-1067)

This investigation has been concerned with hydrogen and oxygen evolution at electrodes and the influence of adsorbed substances. In this report, a.c. measurements of the interface impedance prove to be suitable for studying adsorption phenomena on porous electrodes such as platinated platinum and sintered nickel material. The impedance on platinum electrodes was evaluated for 8 normal H_2SO_4 and 1 normal KOH solution. Further investigations dealt with inhibition problems on highly activated porous-nickel electrodes. Several alcohols were used as additives to 1 normal KOH. The applicability of the potentiostatic method of applying triangular voltages was examined on bright nickel electrodes. The electrolytes 8 normal H_2SO_4 and 1 normal KOH, in general, were stirred with purified nitrogen. The applicability of the potentiostatic method of triangular voltages to show the influence of inhibitors by applying the principle of Wagner–Traut was examined. Author

N63-15817 Florida U. Engineering and Industrial Experiment Station, Gainesville
FLUOROCARBON N-F COMPOUNDS Fifteenth Quarterly Technical Report
R. D. Dresdner, C. S. Patterson, and H. E. Ferran Apr. 1, 1963 11 p
(Contract DA-01-009-ORD-772 and ARPA Order 40-59)
(AROD-007-15)

The new homolog, $C_2F_5N{=}S\ CF(CF_3)_2$, was prepared from $C_2F_5N{=}SF_2$ and $CF_3CF{=}CF_2$ over CsF at higher reaction pressure and lower temperature resulting in a higher yield (80%), faster reaction rate, and fewer side reactions than was encountered in a similar preparation of the next higher homolog, $nC_3F_7N{=}S\ CF(CF_3)_2$. Various IR, NMR, and mass spectral data are presented to confirm the indicated structures. Author

N63-15818 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
DUAL MODE CONTROL
Leonidas M. Mantgiaris Dec. 26, 1962 31 p 8 refs
(Contract DA-ARO(D)-31-124-G144)
(PIBMRI-1104-62; AROD-1538-21)

The purpose of this report is to achieve a simple compensation scheme for the control of a process. The criteria are that the process output closely approximate the process input when the latter is a step and that there be no steady-state error. The reference process chosen is that of chemical-concentration control. Employing a compensation block with pure gain gives a fast response that has a steady-state error. Integral compensation eliminates the steady-state error, but its response has a very sluggish transient character. A switching arrangement is evolved that combines the desirable characteristics of both types of compensations while removing the unwanted traits. This configuration is set up on an analog computer, and compound results which satisfy the original criteria are empirically obtained for a plant of three poles. This is done for plants of two poles and one pole with equal success, exhibiting the validity of the technique for a general plant. Author

N63-15822 Pennsylvania State U. Coll. of Chemistry and Physics, University Park
PREPARATION AND PROPERTIES OF UNSOLVATED ALUMINUM HYDRIDE: THERMAL DECOMPOSITION OF GASEOUS TRIETHYLALUMINUM Technical Report
Thomas Wartik and Wayne Smith (Ph. D. Thesis) Mar. 29, 1963 290 p 128 refs
(Contract Nonr-656(22); ARPA Order 23-59)

Kinetic studies have been conducted on the thermal decomposition of gaseous triethylaluminum in static systems in the temperature range between 162.0° C and 192.4° C. The following species were observed at various stages of the reaction: methane, ethane, ethene, butane, 1-butene, 2-butenes, hexenes, hydrogen, and metallic aluminum. The hydrolysis (D_2O) products included ethane-d_1, butane-d_1, hexane, hydrogen deuteride, deuterium and $CH_x\ D_{4-x}$ where x = 0,1,2, or 3. Data analyses based on the disappearance of the aluminum-ethyl bond were found to satisfy the rate expression for a first-order heterogeneous reaction unretarded by its products, but with weak to moderate absorption of the reactant. A detailed decomposition mechanism is proposed which involves free-radical and molecular processes. Triethylaluminum was found to decompose extremely slowly at room temperature, but essentially complete decomposition was obtained in samples heated for 12 hours at 400° C. M.P.G.

N63-15830 Radio Corp. of America. Semiconductor and Materials Div., Somerville, N.J.

GALLIUM ARSENIDE EPITAXIAL FILM GROWTH Interim Technical Documentary Progress Report No. 2, Dec. 15, 1962 to Mar. 15, 1963

N. Goldsmith Apr. 1963 29 p 2 refs
(Contract AF 33(657)-9179)
(ASD-TR-7-995(II))

Oxygen has been shown to be a major factor in the formation of surface imperfections previously observed. The source of the oxygen in the system was traced to a fault in the palladium furnace. Analyses of commercial hydrochloric-acid samples from several sources have been made showing that impurities up to 0.3% (volume) are frequently present. Doping with sulfur in the form of sulfur monochloride yields maximum donor concentrations of 3.7×10^{18} cm^{-3}. Attempts to achieve higher doping levels with tellurium were not successful. Nondestructive techniques for the measurement of carrier concentration are presented covering the range 10^{15} to 10^{19} for n-type material. Evidence is presented to show that the layers have doping gradients near the interface. Details are given of the procedure for surface preparation, including the etch composition, rotation speed, etch rate, and final rinsing and drying of the wafer. An evaluation of the growth rates is also given. Author

N63-15841 Committee on Nuclear Science. National Research Council, Washington, D.C.

APPLICATIONS OF COMPUTERS TO NUCLEAR AND RADIOCHEMISTRY

G. D. O'Kelley, ed. (Oak Ridge Natl. Lab.) Mar. 1963 311 p 120 refs Proceedings of a Symposium, Gatlinburg, Tenn., Oct. 17–19, 1962
(NAS-NS 3107) OTS: $2.50

This volume contains the papers and a panel discussion presented at the symposium on "Applications of Computers to Nuclear and Radiochemistry." The following are covered: radioactive decay curve analysis; computer analysis of beta- and gamma-ray spectra; scintillation spectrometry; and activation analysis. R.C.M.

N63-15843 Hughes Aircraft Co. Aerospace Group, Culver City, Calif.

ROCKET LINER PROGRAM Seventh Quarterly Report, 1 Jan.–1 Apr. 1962

S. B. Eglin and A. L. Landis [1962] 36 p 6 refs
(Contract DA-04-495-ORD-3079)
(ROC/LIN-7Q)

A series of stannosiloxane polymers have been prepared essentially from phenylmethylsilicon and diorganotin derivatives in which about 40% of the organic ligands are phenyl groups. These polymers were prepared with the aim of preparing an elastomer possessing optimal char-forming properties consistent with retention of strain-tolerance when compounded with inorganic fillers and cured. Preliminary evaluation of pyrolytic behavior of these materials indicated that they are promising candidate materials for the rocket-motor-case-insulation application. Several other polymers including an arsenosiloxane, an aluminosiloxane, and nitrogen-containing silicon polymers have been prepared, and methods for curing these materials with various silicon hydrides have been explored. Author

N63-15844 Naval Ordnance Lab., White Oak, Md.

CHEMICAL AND PHYSICAL EFFECTS OF GLASS SURFACES UPON AN EPOXIDE POLYMER SYSTEM

Porter W. Erickson and Angelo A. Volpe Mar. 11, 1963 22 p 10 refs
(NOLTR-63-10)

The Preferential Adsorption Theory for glass fiber finishes was tested by experiments using a model system and infrared spectroscopy. The results obtained constitute favorable evidence for the formation of a deformable polymer layer at the glass-resin juncture which could relieve presumed deleterious stresses at the interface. Different finishes are presumed to lead to different properties in this deformable layer which would have important effects on laminate strength properties. Author

N63-15865 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

METHOD FOR THE DETERMINATION OF OXYGEN IN MICROGRAM QUANTITIES OF OXIDES OF PLATINUM AND OTHER REDUCIBLE OXIDES

George C. Fryburg and Dumas A. Otterson Repr. from Anal. Chem. v. 35, Apr. 1963 p 586-587 7 refs

A method for determining oxygen in microgram quantities of oxides of platinum is presented; it involves reducing the oxide with hydrogen and determining the resultant water by a microtechnique recently developed. This method should be applicable to any oxide reducible by hydrogen; the only limitation is that the oxide is reducible at a temperature lower than that at which dissociation occurs. Author

N63-15876 Atlantic Research Corp., Alexandria, Va.

DEVELOPMENT OF FLEXIBLE POLYMERS AS THERMAL INSULATION IN SOLID-PROPELLANT ROCKET MOTORS Quarterly Progress Report, July 1 to Sept. 30, 1962

T. R. Walton and E. B. Simmons Oct. 1962 33 p
(Contract DA-36-034-ORD-3325-RD)

Mechanical properties were determined for two of the better insulation materials developed under this program, the 40-percent castor oil-modified Guardian filled with 40 percent of asbestos fibers, and the 1:1 phenol-formaldehyde:Syl Kem 90 resin, filled with 45 percent of asbestos fibers. The ultimate elongations were 6 and 0.4 percent, respectively. However, the mechanical properties of the castor oil-modified Guardian were determined on defective specimens, and thus the elongation of 6 percent represents only a minimum value. Four static-motor firings were made during this report period. Several new formulations were tested. A char rate of 1.7 mil/sec was obtained for an Epon 828:tetrahydrophthalic anhydride:castor-oil formulation filled with 40 percent of asbestos fiber. Specimens containing other fillers besides pure asbestos fibers were evaluated in motor tests. The 40 percent castor oil-modified Guardian filled with 20 percent of asbestos fibers and 20 percent of potassium oxalate had a char rate of 2.4 mil/sec, and showed a slight improvement over the material filled only with 40 percent of asbestos fiber. The castor oil-modified Guardian filled with 40 percent of silica-microballoons had a char rate of 5.0 mil/sec, but a very low density of 0.71 gm/cc. The densities of the 40 percent asbestos and oxalate-filled materials are about 1.45 gm/cc. The effect on the char rate of various amounts of asbestos fibers and asbestos fibers–potassium oxalate ratios in the phenol-formaldehyde:Syl Kem 90 formulation was found to be small. Author

N63-15877 Atlantic Research Corp., Alexandria, Va.

DEVELOPMENT OF FLEXIBLE POLYMERS AS THERMAL INSULATION IN SOLID-PROPELLANT ROCKET MOTORS Second Annual Summary Report, June 30, 1961 to June 30, 1962

N. Vasileff, T. Walton, and J. Duffy July 31, 1962 93 p
(Contract DA-36-034-ORD-3325-RD)

The flexibility of epoxy, melamine, phenolic, urethane, and furan resins for use as thermal insulation binders in end-burning, solid-propellant rocket motors is described. The effect of aging on the mechanical properties of two externally plasticized epoxy resins was determined. For several resins, asbestos fibers, potassium oxalate, and magnesium carbonate fillers were evaluated in the oxy-acetylene-torch test and static-motor firings. The char rates (from motor firings) and densities for the motor promising systems were: 3.0 mil/sec, 1.41 gm/cu cm for an asbestos-filled Epon 828-Nadic

methyl anhydride-castor oil formulation; 2.4 mil/sec, 1.52 gm/cu cm for an asbestos-filled Araldite DP-437-NMA formulation; 2.7 mil/sec, 1.37 gm/cu cm for an asbestos-filled nonyl phenol-formaldehyde-Syl-Kem 90 formulation; and 2.1 mil/sec, 1.50 gm/cu cm for asbestos-oxalate-filled phenol-formaldehyde-Syl-Kem 90 formulation. Author

N63-15917 Rocketdyne, Canoga Park, Calif.
RESEARCH IN FLUORINE CHEMISTRY Summary Report, Mar. 16, 1962 to Mar. 15, 1963
H. H. Rogers, S. Evans and J. H. Johnson Apr. 30, 1963 100 p 3 refs
(Contract Nonr-1818(00))
(R-5077)

This review of electrolysis of anhydrous hydrogen fluoride includes: (1) the drying of hydrogen fluoride by electrolysis; (2) the hydrogen fluoride–nitrous oxide system; (3) the hydrogen fluoride–dinitrogen tetraoxide system; and (4) the hydrogen fluoride–nitric oxide system. I.v.L.

N63-15928 International Union of Pure and Applied Chemistry
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS
L. Brewer (Calif. U.), comp. Mar. 31, 1963 20 p 160 refs

N63-15933 California U., La Jolla. School of Science and Engineering
ON A POSSIBLE CORRELATION BETWEEN CLASSIFICATIONS AND K-A AGES OF CHONDRITES
Klaus Keil [1963] 8 p 19 refs Submitted for Publication
(NASA Grant NsG-322-63)
OTS: $1.10 ph, $0.80 mf

A possible correlation between two gas retention age groups and the high (H) and low (L) iron group chondrites was investigated. Frequency distribution curves of the K-A ages of stony meteorites show two distinct maxima, 4.5×10^9 years and 1×10^9 years. This indicates substantial degassing, which is now shown to be much more frequent for the L group of chondrites than for the H group. J.A.J.

N63-15950 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
STUDY OF THE NITRATION OF 3,3,3-TRIFLUORO-1,2-EPOXYPROPANE
Yvon P. Carignan Apr. 1963 30 p 18 refs
(PA-TR-3055)

3,3,3-Trifluoro-1,2-epoxypropane, CF_3–$CHOCH_2$, was nitrated with (1) 98% nitric acid, (2) mixed acid (H_2SO_4:HNO_3, 1:1 by wt), and (3) boron trifluoride-nitric acid complex. Each nitrating agent afforded the desired 3,3,3-trifluoro-1,2-propane dinitrate, CF_3–$CHONO_2$–CH_2ONO_2 together with variable amounts of the two mononitrates CF_3–$CHOH$–CH_2ONO_2 and CF_3–$CHONO_2$–CH_2OH. Under the conditions of the experiments, only with the boron trifluoride-nitric acid complex were reasonable yields of the dinitrate obtained. During this study, it was observed that the dinitrate was partially hydrolyzed (20%) on a silica gel column to the mononitrate CF_3–$CHOH$–CH_2ONO_2. Author

N63-15952 Retina Foundation. Inst. of Biological and Medical Sciences, Boston, Mass.
STUDIES OF CERTAIN BIOLOGICALLY IMPORTANT POLYANION-ORGANIC CATION COMPLEXES AS ENERGY TRANSFER SYSTEMS Scientific Report No. 3
Endre A. Balazs and D. S. Scheufele Oct. 31, 1962 14 p 12 refs
(Contract AF 19(604)-8476; ARPA Order 171-62)
(AFCRL-63-426)

Visible absorption spectra of Azure A interactions with glucosaminoglycans and sodium polyethylene sulfonates were determined—the latter polyanions with regard to the effects of method of preparation; polymer anionic site to dye ratio; temperature; buffering; centrifugation and chloroform extraction; and the forms polyanions with respect to a fixed amount of excess dye and decreasing polyanion concentration. Author

N63-16038 Comision Nacional de Energia Atomica, Buenos Aires (Argentina)
[LUMINESCENT DERIVATIVES OF BORAZOL AND THEIR APPLICATION IN COUNTING THERMAL NEUTRONS] DERIVADOS LUMINISCENTES DEL BORAZOL, SU APLICACION AL CONTAJE DE NETRONES TERMICOS
G. J. Videla, M. A. Molinari, E. A. Rojo, O. A. Lires, and L. H. Casas 1962 11 p 5 refs In SPANISH
(*Its* Informe 77)

The method of general purification is modified and used to prepare the luminescent derivatives of Borazol; and the spectrums of fluorescent excitation is determined. The thermal neutron count, determined from tables of relative efficiency and various gamma-ray strengths, is given. Some results were obtained from experiments with solid borazols. Results showed that there are some advantages in measuring thermal neutrons by this method as compared to methods that use conventional counters. Trans. by P.F.E.

N63-16102 Armour Research Foundation, Chicago, Ill.
A STUDY OF FREE RADICALS AND OTHER INTERMEDIATE SPECIES AND INTERNAL ENERGY TRANSFER PROCESSES IN IRRADIATED CHEMICAL SYSTEMS [Final Report, Sept. 15, 1960-Mar. 14, 1962]
P. Y. Feng and B. K. Krotoszynski Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Sept. 1962 53 p 20 refs
(Contract AF 33(616)-7587)
(ASD-TDR-62-540)

This report describes a study of the role of internal energy transfer processes in radiation chemical reactions involving free radicals and other intermediate species, using a series of alkyl iodides with different carbon chain lengths as the experimental systems. It was found that (1) with increasing size of the alkyl group in a homologous series—for example, the 1-iodoalkanes—the extent of C-I bond rupture decreases regularly, whereas both the H_2 and the HI yields increase; (2) products with practically identical yields are formed in the radiolyses of two systems with similar elemental compositions, one consisting of pure $C_{16}H_{33}I$, and the other an equimolecular mixture of C_8H_{18} and $C_8H_{17}I$. Analysis of these results, together with those available in the literature, shows that energy initially localized elsewhere in an alkyl iodide molecule cannot efficiently cause C-I bond breakage, despite the latter's low bond strength; i.e., internal energy transfer does not play an important role in these reactions. Instead, it is concluded that the product yields are dependent on the effective electron fractions of the various groups in the irradiated system, a parameter which permits the quantitative correlation of the outcomes of the radiolytic reactions investigated in this program. Author

N63-16141 Comision Nacional de Energia Atomica, Buenos Aires (Argentina)
[KINETICS OF OXIDATION STATE OF URANIUM DIOXIDE IN AIR] CINETICA DE OXIDACION DE UO_2 EN AIRE
Carlos Aráoz 1962 29 p 21 refs In SPANISH
(*Its* Informe 74)

An experiment was completed on the analysis of the thermal differential of powdered uranium dioxide in the temperature range from 25° C to 600° C. Two types of exothermal characteristics were found: (1) the reaction UO_2-$U_{2.3}$ controlled by diffusion to 210°; (2) the reaction $UO_{2.3}$-U_3O_8, a process of nucleation and rupture of powder grains. There is a small intermediate type or

process that may be attributed to the thermal inhomogeneity of the system. Nonstoichiometric oxides are not manifested by this method, although they are more susceptible to oxidation than stoichiometric types, under similar physical conditions. Powder with a different initial content of oxygen, with the ratio of O/U varying from 2.02 to 2.37, showed a variation in height (graph) of the first type according to the oxygen content. The height (graph) of the second type remained fixed. The graph O/U vs. the height of the first type showed a change in composition on the order of 2.25, which was interpreted as an orthorhombic phase of the order of 2.25. Calibration of these curves in calories agrees with those given in previous papers. Trans. by P.F.E. and J.A.J.

N63-16144 California U., Livermore. Lawrence Radiation Lab.
ABSORPTION SPECTRA OF VARIOUS METALLIC HALIDES AND OXIDES, ELEMENTAL CARBON, AND THE INERT GASES: A BIBLIOGRAPHY
Jean E. Senkin and M. Temple Milliken, comps. Feb 1, 1963 94 p 814 refs
(Contract W-7405-eng-48)
(UCRL-7238) OTS: $2.25

The bibliography is the result of a search of *Chemical Abstracts* (1927–1962) and includes references to data on absorption spectra of various hydrides, halides and oxides of alkali, alkaline earth, and several transition elements. Also included are references on spectra of elemental carbon and the inert gases. Author

N63-16146 Atomic Energy Commission, Bombay (India)
SELECTED BIBLIOGRAPHY OF OXIDES OF CADMIUM
V. D. Damani, comp. 1962 46 p 277 refs
(AEET/CD/11)

N63-16223 Stanford Research Inst., Menlo Park, Calif.
INFRA-RED CONFIRMATION OF 6-FOLD CO-ORDINATION OF SILICON IN STISHOVITE
R. J. P. Lyon Repr. from Nature, v. 196, no. 4851, Oct. 20, 1962 p 266-267 4 refs
(NASA Contract NASr-49(04))

By infrared absorption techniques, curve line graphs were constructed to compare the absorption peaks of fused silica, quartz, coesite, and stishovite. The results show a marked change in the position of the major absorption peaks when passing from the SiO_4 tetrahedral coordinate of quartz, coesite, and fused silica (1,098-1,077cm^{-1}) to the SiO_6 octahedral coordination in stishovite (769-628cm^{-1}; 949-885cm^{-1}). Stishovite is considered to be the first mineral discovered in which silicon occurs with oxygen in a 6-fold coordinate (octahedral) instead of a tetrahedral coordinate. N.E.A.

N63-16164 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABULATED VALUES OF BOND DISSOCIATION ENERGIES, IONIZATION POTENTIALS, AND ELECTRON AFFINITIES FOR SOME MOLECULES FOUND IN HIGH-TEMPERATURE CHEMICAL REACTIONS
Charles J. Schexnayder, Jr. Washington, NASA, May 1963 63 p 113 refs
(NASA-TN-D-1791) OTS: $1.75

Values of the bond dissociation energies, ionization potentials, and electron affinities that were taken from the literature are presented in tables for some monatomic, diatomic, and polyatomic molecules which are found in many high-temperature chemical reactions including combustion reactions. Much of the information came from literature published after 1950, which either reported experimental and theoretical energy values or gave a review of previous literature on the subject. Author

N63-16167 Pratt and Whitney Aircraft, Middletown, Conn.
THE DETERMINATION OF URANIUM ISOTOPE ABUNDANCES AND REACTOR FUEL BURNUP BY MASS SPECTROMETRY
D. E. Fornwalt, M. Kahn Apr. 30, 1963 27 p 4 refs
(Contract AT(30-1)-2789)
(PWAC-393) OTS: $0.75

The theory and use of a triple-filament thermal-emission source and mass spectrometer used for the measurement of isotopic abundances and reactor fuel burnup are described. It is shown that uranium isotopic abundances may be measured at the 0.03- to 95-percent levels with a standard deviation of 0.002 to 0.018, respectively, with an accompanying relative error of from 4.2 to 0.06 percent, respectively. The method used to determine reactor fuel burnup is described, and is shown to have a standard deviation of 0.14 and 0.03 at 9.35 percent fission burnup and 1.59-percent capture levels, respectively. A comparison of burnup measurements made by the mass spectrometer method is shown to agree favorably with the radiochemical technique. Author

N63-16181 United States Rubber Co. Naugatuck Chemical Div., Conn.
SYNTHESIS OF REGULATED STRUCTURE POLYPHENYL-ETHER-SILOXANE BLOCK COPOLYMERS Quarterly Progress Report No. 6, Oct. 31, 1962–Jan. 31, 1963
Robert Mac Farlane, Jr., and Eugene S. Yankura [1963] 21 p
(Contract DA-19-020-ORD-5507)

The large-scale high-temperature alkaline hydrolysis reaction was worked up, and of several specialized techniques employed to purify the final product, one was very successful. The catalyst concentration and form was found to be a major factor in this reaction, and a factorial experiment was begun to study this and four other parameters. Tetrahydrofuran was found to be a successful solvent for the measurement of molecular weights of monomers and polymers using the vapor pressure osmometer. Thin-layer chromatography has been instituted as a successful analytical tool to expedite this program. A literature search uncovered no new specific reference to the synthesis of 4,4'-dihydroxypolyphenylethers or p,p'-dihydroxypolyphenylethers, but did focus attention on a phenol via cumene route which holds promise as an adaptable technique. Author

N63-16194 Resin Research Labs., Inc., Newark, N. J.
SYNTHESES OF ADDITIVES FOR IMPROVING HEAT STABILITY OF ELASTOMERIC VULCANIZATES
Alan E. Weinberg and Roy H. Cook Nov. 1, 1962 77 p 15 refs
(Contract DA-11-070-508-ORD-1200)
(Rept. 2)

The objective of this work was to synthesize chemicals not commercially available which would increase the heat stability of various types of elastomers. Specifically, silicone, fluorocarbon, and diene elastomers were evaluated. Two classes of compounds were selected for synthesis: (1) derivatives of dithiooxamide and (2) organometallic chelates. Details describing the synthesis of the dithiooxamide derivatives and the organometallic chelates are included. Addition of these materials to the test elastomers (diene, silicone, and fluorocarbon) followed by vulcanization and heat aging showed the following results: (1) Of the thirty-seven derivatives of dithiooxamide prepared, only two—N,N'bis(hydroxyethyl) dithiooxamide cobalt (II) and N,N'dibenzyl-dithiooxamide cobalt (II)—showed any significant activity as high-temperature stabilizers and then only when used with fluoroelastomers. (2) Nickel chelates of benzoin oxime and ethylene-diamine-o-cresol in admixture with pentaerythritol and a proprietary amine, when compounded in sulfur-cured SBR vulcanizates, displayed better resistance to degradation during exposure at 300° F than did the control. However, these materials did not provide protection equal to that offered by the best inhibitor system found to date, i.e., cadmium-barium fatty

acid soaps–chelator mixture and the aforementioned amine. (3) Cobalt and nickel chelates of 8 hydroxy-quinoline appear to provide protection for fluoroelastomers during a twenty-four hour exposure at 600° F; however, these stabilizers lose their effectiveness when the exposure is extended to forty-eight hours. Author

N63-16223 Stanford Research Inst., Menlo Park, Calif.
INFRA-RED CONFIRMATION OF 6-FOLD CO-ORDINATION OF SILICON IN STISHOVITE
R. J. P. Lyon Repr. from Nature, v. 196, no. 4851, Oct. 20, 1962 p 266–267 4 refs
(NASA Contract NASP-49(04))

By infrared absorption techniques, curve line graphs were constructed to compare the absorption peaks of fused silica, quartz, coesite, and stishovite. The results show a marked change in the position of the major absorption peaks when passing from the SiO^4 tetrahedral coordinate of quartz, coesite, and fused silica (1,098-1,077cm^{-1}) to the SiO^6 octahedral coordination in stishovite (769-628cm^{-1}; 949-885cm^{-1}). Stishovite is considered to be the first mineral discovered in which silicon occurs with oxygen in a 6-fold coordinate (octahedral) instead of a tetrahedral coordinate. N.E.A.

N63-16248 Atomic Energy Research Establishment, Harwell (Gt. Brit.)
SPECIAL CERAMICS SYMPOSIUM, 1962—PYROLYTICS SESSION. THE DEVELOPMENT OF NEW TYPES OF PYROLYTIC CARBON
K. W. Carley-Macauly and M. Mackenzie June 1962 38 p 17 refs
(AERE-R-3949)

Methods of forming carbon by the pyrolysis of gases containing carbon have been investigated. One process which has been given particular study comprises the impregnation of a bed of porous nonconsolidated carbon, in which a large temperature gradient is maintained, with carbon formed by the pyrolysis of a hydrocarbon gas. Cotton wool, wrapped onto a carbon former and baked, has provided a suitable base for impregnation. It has been found that hydrocarbons higher than methane are not generally suitable as a source of the pyrolytic carbon because of changes which occur on heating subsequent to deposition. These changes are reduced at low-pressure operation, but only methane seems capable of giving permeabilities in the region of 10^{-10} cm^2/sec. The product (HXT) has high strength but is incompletely graphitized after heating to 2700° C. Author

N63-16255 Aberdeen Proving Ground. Coating and Chemical Lab., Md.
MEDIUM ALKALINITY CLEANERS OF SUPERIOR DETERGENCY
A. Mankowich Apr. 16, 1963 14 p 2 refs
(CCL-140) OTS: $0.50

The inefficiency of medium alkalinity (ca pH12), soak alkaline cleaners in deterging calcium soap-grease was overcome in two ways, viz, by incorporating a small amount of the organic chelating agent, tetrasodium salt of EDTA and causing removal by an exchange mechanism, or by the addition of a small amount of specific high-boiling high-flash point glycols which produce stable, single-phase detergent solutions possessing synergistic power. Author

N63-16260 Naval Research Lab., Washington, D.C.
LABORATORY SCALE OPERATION OF THE SULFATE CYCLE FOR CARBON DIOXIDE REMOVAL AND OXYGEN GENERATION
A. L. Pitman and S. T. Gadomski Jan. 17, 1962 15 p 8 refs
(NRL-5714) OTS: $0.50

A laboratory-scale sulfate-cycle pilot plant has been constructed and operated for 70 hours of intermittent service, with the last run in this series lasting 24 hours. This joint operation of the major components, which had previously been evaluated separately, was quite satisfactory despite minor difficulties in the electrolyzer, which have been attributed primarily to the diaphragms. The chrysotile asbestos used in the diaphragms, particularly on the anode side, gradually decomposed and then plugged the diaphragms. A solution to this problem is in sight. Current efficiencies for oxygen, sulfuric acid, hydrogen, and sodium hydroxide have been substantially the same in joint operation as in separate electrolyzer operation. The electrolyzer was still operable on completion of the last run, an indication of the overall reliability of the system. The average oxygen production rate in the joint operation runs was 14.4 liters per hour or 0.51 cu ft per hour. In the 24-hour joint operation run, the average oxygen output of the electrolyzer was 14.0 liters per hour whereas the average rate of carbon dioxide removal from the neutralizer was 13.0 liters per hour. Author

N63-16279 Shell Development Co., Emeryville, Calif.
DEVELOPMENT OF HIGH TEMPERATURE LAMINATING RESINS Quarterly Progress Report No. 1, June–August, 1962
H. H. Chen, J. C. Illman, C. G. Schwarzer, and E. C. Shokal 1962 39 p 14 refs
(Contract AF 33(657)-9063)
(Rept. S-13859)

Epoxy-resin laminating systems are being developed for high-temperature applications, the goal being a service life of 30,000 hours at 650° F. Several promising epoxy resins have been synthesized, including glycidyl ethers of polyphenols, a glycidyl ether-glycidyl benzene resin, glycidyl ethers of polynuclear aromatics, and a tri(epoxyethyl) benzene. Preliminary curing studies have been made with these resins using anhydrides, BF_3 complexes, and aromatic polyamines as curing agents, and they are being screened, either as castings or laminates for thermal stability using weight loss, differential thermal analysis and thermogravimetric analysis as test methods. Mechanical properties of the more promising laminates will also be determined as a function of temperature and time of aging. Preliminary results indicate that the following resins show the most promise to date, although none meets the target requirements: the polyglycidyl ether of hexakis(hydroxyphenyl)1,3,5-triethylbenzene; the polyglycidyl ether of 1,2,2,3-tetra(hydroxyphenyl) propane; and 1,3,5-tri(epoxyethyl)benzene. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-15783 Granger Associates, Palo Alto, Calif.
GRANGER ASSOCIATES POINT-TO-POINT LOG PERIODIC ANTENNA SYSTEM Final Report
W. E. Moore Jan. 1963 62 p 10 refs
(Contract ARDS-583)
(*Its* Publ. 0066-1)

The electrical characteristics of log periodic, high-frequency antennas installed for the Federal Aviation Agency Research and Development Service at Barnegat, New Jersey, and San Juan, Puerto Rico, sites are described. The antenna at Barnegat is a horizontally polarized Granger Associates Model 748 receiving antenna modified to meet special requirements of the FAA. The antenna at San Juan is a standard Granger Associates vertically

polarized Model 726-2.5/30-T transmitting antenna. The results of model radiation-pattern measurements, impedance measurements, ground-reflection calculations, and cable-attenuation calculations are given for the Barnegat antenna. The general radiation pattern, results of impedance measurements, and cable-attenuation calculations are given for the San Juan antenna. Calculated values of installed gain are derived for each antenna. Author

N63-15789 Illinois U. Antenna Lab., Urbana

A STUDY OF WAVE PROPAGATION ON HELICES

Paul William Klock Mar. 1963 163 p 65 refs

(Contract AF 33(657)-10474)

(Tech. Rept. 68)

The determinantal equation for a narrow tape helix is derived of two methods, and complex-valued solutions for the phase constant are obtained. The complete k - β diagram (Brillouin diagram) is given as a function of tape width and pitch angle. In order that the solutions be continuous functions of k and β, it is necessary to change branches of the square root which appears in the determinantal equation. A discussion of solutions which are physically admissible as complex wave solutions is given, and the phase constants corresponding to the complex wave solutions are used to represent the current on a helix. Two source problems are investigated, one an infinite helix, the other a finite helix. Comparison with experiments is made with good agreement. Author

N63-15861 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

RESEARCH CONCERNING FORECASTING ANOMALOUS PROPAGATION AT HIGH LATITUDES Final Report (Item 1)

S. C. Coroniti, J. R. Herman, G. E. Hill, R. B. Penndorf, and G. F. Rourke Feb. 28, 1963 80 p 98 refs

(Contract AF 19(604)-4092)

(RAD-TR-63-15; AFCRL-63-54)

Research concerning variations in the Arctic ionosphere and polar radiopropagation conditions has been carried out for the past several years. The objective has been to obtain information useful for forecasting anomalous propagation conditions and improving radio communications in the high-frequency band at high latitudes. Results of the research are given in the form of abstracts to all scientific reports and papers issued during the course of the work. Eighteen scientific reports and twenty-one related journal articles have have been published; and in addition, seventeen symposium papers have been presented. Appendix V-A contains an extensive bibliography concerning PCA, auroral zone absorption, and related geophysical phenomena. A brief discussion of the detection techniques, characteristics, and causes of anomalous high-latitude absorption is given. A list of polar cap absorption (PCA) events occurring during the first six months of IGY is given along with the appropriate synoptic fmin charts in appendix V-B. Author

N63-15945 Aerospace Corp., El Segundo, Calif.

RE-EXAMINATION OF MINIMUM RANGE CRITERIA FOR RADAR CROSS SECTION MEASUREMENTS

Lee Hendrick and Robert E. Kell Buffalo, N.Y., Cornell Aeronautical Lab., Inc., Aug. 3, 1962 25 p 1 ref

(Contract AF 04(647)-930)

(CAL Rept. GM-1580-G-101)

The necessity of specifying the type of error allowable in making radar cross-section measurements is noted, together with the futility of requiring all measured data to fall within a specified error band. It has been demonstrated that, for a long target characterized by a few scattering regions with small maximum dimension of cophased area, error in measured radar cross section incurred by testing at range less than L^2/λ may be negligible, and that for targets 50 wavelengths long, measurements may be made for most system purposes at 1/4 L^2/λ. It has further been shown that the error produced by using too narrow an antenna beam may be much more serious than that of using too short a range. The need for relatively larger ranges in testing short targets has been pointed out. Author

N63-15967 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.

HIGH ALTITUDE X-BAND NOISE MEASUREMENTS Research Report

S. Hunt, A. S. Orange, and K. Glick Apr. 1963 37 p 1 ref

(AFCRL-63-87)

X-band-noise temperature data obtained with an airborne radiometer installed in a high-speed jet aircraft (KC-135) is presented. The aircraft was found to be an electrically quiet environment at X-band. The data show the considerable influence of blackbody radiation from the earth entering the antenna sidelobes. Temperatures close to those calculated theoretically were measured over water and at high antenna-elevation angles. Heavy clouds, though many thousands of feet below the aircraft, caused a considerable temperature increase. A trend of lower temperatures with increasing altitude was observed. The apparent temperatures of land, snow, and ice and water are discussed. Author

N63-15973 Lincoln Lab., Mass. Inst. of Tech., Lexington

RADIO PHYSICS Division 3—Quarterly Progress Report [Apr. 1–June 30, 1962]

J. V. Harrington Aug. 8, 1962 20 p refs

(Contract AF 19(628)-500)

(AFESD-TDR-62-116)

Progress is reported in the following areas: (1) radio propagation; (2) communication techniques; (3) plasma physics; (4) communications systems; (5) surveillance radar techniques; and (6) antennas. I.v.L.

N63-15998 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

TELEMETRY DEVELOPMENT FOR LARGE GUIDED MISSILES AND SPACE CARRIER VEHICLES

Otto A. Hoberg and James E. Rorex *In its* From Penemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 487–516 (See N63-15976 13-01)

Telemetry component development is reviewed and it is found that much of the space-vehicle design rests on the telemetry system it utilizes. Telemetry systems have been developing from the days of V-2 rockets through the Redstone and Saturn carrier vehicles, with each system becoming more refined and more sophisticated. With each new system, the reliability, accuracy, and bandwidth utilization have been increased, whereas the size, weight, and power requirements have been reduced. The systems of tomorrow will be further improved, using such techniques as micromodules and improved modulation techniques with more efficient carriers, receivers, and antennas. D.E.R.

N63-15999 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

APPLICATION OF THE DOPPLER PRINCIPLE TO ROCKETRY

Karl Sendler, James R. White, and Rudolf Bruns *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemmorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 517–533 (See N63-15976 13-01)

The application of the Doppler effect to rocketry and space vehicles is discussed. The general philosophy of Doppler tracking systems is presented: the Dovap system is explained as well as the Udop and Beat-Beat systems. The applications of these tracking systems to orbital and deep space probes and the new Radop concept are outlined. D.E.R.

N63-16002 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

GROUND VERSUS ON-BOARD TRACKING FOR SPACE NAVIGATION

F. A. Speer and H. F. Kurtz *In its* From Peenemünde to Outer Space: [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 573-599 4 refs (See N63-15976 13-01)

The relative merits of ground tracking versus on-board tracking are discussed for a spectrum of space missions including orbital, lunar, and escape. The comparison is made from a general operational viewpoint and from the viewpoint of tracking accuracy and tracking speed. It is concluded that ground tracking has a strong early advantage during all missions, but on-board tracking improves as flight time and distance increase. R.C.M.

N63-16066 Illinois U. Antenna Lab., Urbana

POLYGONAL SPIRAL ANTENNAS

C. H. Tang and O. L. Mc Clelland June 1962 70 p 21 refs
(Contract AF 33(657)-8460)
(Tech. Rept.-57)

By relaxing the similarity condition on the angular structures, a class of modified angular structures when used as antennas are shown to have frequency-independent performances. The class of log-periodic antennas belongs to the modified conical structure which is a special case of the general angular structure. The general angular structure can be described by log-spiral curves which lead to the design of log-spiral antennas. In this report, modifications are made on the general angular structures with the view of obtaining a larger class of frequency-independent antenna design. The measurements taken on some of the structures give the desirable results. Author

N63-16129 Northrop Corp., Anaheim, Calif.

THE REAL-TIME PROCESSING OF TELEMETRY DATA BY ALERT, A ONE MEGACYCLE COMPUTER Technical Paper

L. M. Newberry and J. F. Colbert Mar. 31, 1963 15 p 9 refs
(NSS-2579)

This paper describes Alert, a 1-megacycle computer, specially designed and developed for the reception and real-time processing of telemetry data for prelaunch automatic checkout and in-flight monitoring of an airborne vehicle. The computer can also process this data from high-speed playback of magnetic tape for off-line processing. The requirements of real-time telemetry data processing are given for various phases of vehicle validation. These requirements include: types of data encountered, data rates, processing functions, etc. The Alert computer, including the high-speed buffer, the independent input programmer, the dual memory, and its telemetry data processing cycle, are described. Author

N63-16221 New York U. Coll. of Engineering, N. Y.

THE PERFORMANCE OF A FLAT-STAGGERED FILTER BANK FOR RECOVERING TONE BURST TELEMETRY SIGNALS

Bernard Harris and Robert C. Sommer Jan. 29, 1962 10 p
(NASA Contract NAS5-408)
(Tech. Memo. 23) OTS: $1.10 ph, $0.80 mf

The performance of filter banks composed of single-tuned and two isolated, cascaded, synchronously-tuned circuits were evaluated previously. The performance of a bank of filters, each one of which is composed of two isolated, cascaded, flat-staggered circuits, is herein evaluated and compared with that of a bank of single-tuned filters. For brevity, this filter is referred to as a flat-staggered pair. The performance of the flat-staggered pair is found to differ only slightly from that of the single-tuned filter. Compared to the single-tuned filter, the average signal-to-noise ratio is found to be 0.68 db superior, whereas the average resolution signal-to-noise ratio is bound to be 0.86 db inferior. Author

N63-16316 Illinois U. Antenna Lab., Urbana

AN INVESTIGATION OF THE NEAR FIELDS ON THE CONICAL EQUIANGULAR SPIRAL ANTENNA

O. L. Mc Clelland May 1962 59 p 13 refs
(Contract AF 33(657)-8460)
(Tech. Rept. 55)

The current distribution has been measured on a conical, equiangular, spiral antenna. A correlation between the operation of the conical log-spiral antenna and the operation of the uniform, circular bifilar helix is established by utilizing a general theory of backward wave radiation from periodic structures. Operation beyond the normal frequency limits has been explored and discussed. The arms of the antenna were constant diameter conductors. The effects of this deviation from the ideal design, which calls for a linearly increasing diameter, have been observed. The far-field measurements giving, for example, the center of phase location, agree with the near-field probing. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-15788 Servomechanisms, Inc. Research and Development Center, Goleta, Calif.

ARMY/NAVY INSTRUMENTATION PROGRAM: ORGANIC FILM TUNNEL EMISSION INVESTIGATION Final Report

Gordon N. Steele Mar. 1963 30 p 3 refs
(Contract Nonr 1076(00); Purchase Contract T&M 5615-C)
(SMIR 63-1)

In contrast to the work reported here, the conventional approach to the solid-state triode based on electron tunneling has resulted in disappointingly small emission currents. It is hypothesized that two primary factors are responsible for this. These are: the rounding off of the dielectric barrier at the emitter–dielectric interface causes hot electrons to tunnel by internal field emission within the dielectric rather than injection from the metal; and the highly ionic nature of the oxides conventionally employed for the dielectric is responsible for excessive scattering of the hot electrons within the dielectric. A method of circumventing both of these factors appears to be possible by substituting a polarized organic film for the conventional inorganic dielectric. Of a series of organic compounds tested for this purpose, an organic dye, fluorescein, was found to be most suitable. Employing this compound, techniques were developed for vacuum depositing pinhole-free dielectric films over the thickness range of 30 Å to 2000 Å when the receiving surface was Nesa glass. Received on silver film surfaces, no pinhole-free dielectric films were obtained. Current vs. voltage curves implies electron tunneling through fluorescein for thicknesses 30 Å to about 200 Å. Currents achieved are a factor of 10^4 greater than those reported for inorganic dielectrics of otherwise similar structure. Author

N63-15816 Hughes Aircraft Co., Culver City, Calif.

AN EXPERIMENTAL NEGATIVE-CONDUCTANCE SLOT AMPLIFIER AT 6 GC Scientific Report No. 4

M. C. Behnke and A. P. King July 1962 27 p 17 refs
(Contract AF 19(604)-8386)
(AFCRL-62-583)

This report describes an experimental study of a tunnel-diode amplifier. The purpose of this device was to provide signal gain for the slot elements employed in an experimental, simultaneously-scanned antenna array. Each slot element comprised a resonant lot

coupled to the waveguide broadwall. The diode was asymmetrically placed in the slot to transform the diode impedance to that of the antenna slot. Some of the attractive features of this type amplifier include design simplicity, light weight, and with suitable circuitry, a low-noise figure. These devices are relatively radiation resistant and offer possibilities for future consideration in space-vehicle application. Experimental results at 6 kmc have yielded gains in excess of 15 db with commercially available diodes. Tunnel diodes capable of operating at frequencies of 10 kmc and higher are beginning to appear on the market. With suitable circuitry, a lower noise figure than obtained with a conventional balanced-crystal converter can be expected. Noise figures in the 5 to 7 db range at frequencies up to 10 kmc can be obtained with the use of circulators. Some consideration of the noise problem with tunnel diodes is included. Author

N63-15825 Lockheed Missiles and Space Co., Sunnyvale, Calif.

A MAGNETIC REVERSIBLE COUNTER WITH DIGITAL-TO-ANALOG CONVERSION. PHYSICAL ELECTRONICS [Final] Technical Report

Larry M. Cohen Apr. 1963 47 p 8 refs

(LMSC-6-90-63-29)

This report describes a time-shared, two-channel magnetic counter and digital-to-analog converter. The counter is capable of performing unit addition and subtraction. The design objective—to reduce the number of components—was well satisfied by the use of all-magnetic shift registers as the storage elements. Only two components are required for magnetic storage, whereas ten components were required for transistor flip-flop storage. The logic operations were performed by time-shared diode gate circuits. The calculated worst-case error for the digital-to-analog conversion is ±0.3 percent. The measured error is less than ±0.25 percent. This error is due to variations in the bulk resistivity of diodes and PNPN switches, and it can be reduced, theoretically, to less than ±0.1 percent. Author

N63-15842 Stanford U. Microwave Lab., Calif.

FOLDOVER IN DIODE-LOADED RESONANT CIRCUITS Technical Note

Robert Edward Tokheim Aug. 1962 36 p 4 refs

(Contract AF 49(638)-415)

(ML-945)

Experimental investigation of foldover has been made in a medium frequency series resonant circuit using two back-to-back Varicap diodes. Foldover of this nature is a phenomenon of some importance in several practical devices, including bistable switching circuits, the parametron, the parametric limiter, the parametric amplifier, and the harmonic generator. The purpose of this study was to determine how well such foldover could be predicted from theory for the series circuit. Theoretical results were based upon precise measurements of the individual circuit components. Very good agreement of theory with experiment was obtained, assuming only the fundamental frequency term in the harmonic balance method of solving the nonlinear differential equation. Author

N63-15886 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho

A TRANSFER FUNCTION FOR D. C. OPERATIONAL AMPLIFIERS WITH GENERALIZED EXTERNAL NETWORKS

S. R. Gossmann AEC National Reactor Testing Station, Feb. 25, 1963 18 p

(Contract AT(10-1)-205)

(IDO-16809) OTS: $0.50

A transfer function for d.c. operational amplifiers with generalized input and feedback networks is derived by application of network theory. This transfer function is more general than others in common use in that it applies to three- and four-terminal networks. It contains, as a special case, the well-known transfer function for d.c. operational amplifiers with two-terminal networks. Author

N63-15892 Illinois U. Antenna Lab., Urbana

THEORETICAL STUDY OF A CLASS OF LOGARITHMICALLY PERIODIC CIRCUITS

Raj Mittra July 1962 34 p 5 refs

(Contract AF 33(657)-8460)

(Tech. Rept. 59)

Closed-form expressions for the lumped Foster-type log-periodic (LP) network are derived along with the characteristic equation for an infinite log-periodic loaded transmission line. A method of solution for this equation is discussed so as to develop a better understanding of the behavior of the LP dipole antenna. A general approach toward studying a class of LP structures is presented in terms of the Brillouin diagrams of the corresponding simply periodic structures. R.C.M.

N63-16016 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF LINEAR BEAM MICROWAVE TUBES Final Report, Vol. II, Oct. 1, 1961 to Sept. 30, 1962

G. Conrad Dalman et al [1962] 293 p 113 refs

(Contract AF 30(602)-2573)

(Res. Rept. EE-556; RADC-TDR-63-1, Vol. II)

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2. RESPONSE OF KLYSTRONS TO NANOSECOND PULSES N. Bose 77 p 5 refs (See N63-16018 13-09)
3. NANOSECOND STUDY P. R. Mc Isaac 10 p (See N63-16019 13-09)
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5. REDUCTION OF SPURIOUS-OUTPUT SIGNALS IN HIGH-POWER KLYSTRONS A. R. Howland, Jr. 24 p 4 refs (See N63-16021 13-09)

N63-16017 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

A RELATIVISTIC STUDY OF THE LLEWELLYN ELECTRONIC GAP AND ITS APPLICATIONS Technical Report

Cheng Sun *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. II Feb. 15, 1962 76 p 9 refs (See N63-16016 13-09)

(Contract AF 30(602)-2573)

(Rept. 18; Res. Rept. EE-525)

The Llewellyn relativistic coefficients have been solved in the range $v_0^2/2_c < 1/2$, corresponding to 2.115×10^5 volts. These results are applied to high-frequency space-charge-limited diodes and to klystrons in which space-charge effects are not considered. In such klystrons, the range can be extended without limit. The current and velocity modulation and the diode impedance are derived for high-frequency space-charge-limited diodes. Here the maximum diode resistance at 2.115×10^5 volts changes only 0.3 percent in comparison to the nonrelativistic case. For the klystron case, velocity modulation and beam-loading admittance are calculated at the first gap and are found to change from the nonrelativistic case by a large amount. The current and velocity behavior in the drift region are derived, and the transadmittance for the klystron is also given. It is concluded that the relativistic effect is small for high-frequency space-charge-limited diodes, but significant for klystron tubes. Author

N63-16018 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

RESPONSE OF KLYSTRONS TO NANOSECOND PULSES Technical Report

N. Bose *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. II Sept. 30, 1962 77 p 5 refs (See N63-16016 13-09)
(Contract AF 30(602)-2573)
(Rept. 21; Res. Rept. EE-542)

This investigation uses ballistic theory in the analysis of the behavior of an electron beam passing through alternate gap and drift regions, with the gap regions having excitation fields. The analysis develops the response to a complicated frequency spectrum of the drive signal. First the double frequency case is analyzed. Relativistic effects are taken into account and their influence on the current response studied. The theory is extended to the more complicated case of a Gaussian spectrum. The first-order bunching theory is used to plot current response curves. An estimate of the pulse distortion resulting from nonlinear electron-beam dynamics is obtained from the curves. It is also of interest that the envelope shape of the exit current is almost completely independent of the rf frequency. The large-signal, finite-gap analysis is carried out, and and the results extended to the multiple-cavity klystron. Author

N63-16019 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

NANOSECOND STUDY Technical Report

P. R. Mc Isaac *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. II Sept. 30, 1962 10 p (See N63-16016 13-09)
(Contract AF 30(602)-2573)
(Rept. 20; Res. Rept. EE-541)

The response of a microwave tube resonant cavity with a Gaussian envelope to the frequency of the input pulse is studied. Distortion of the output voltage pulse is described as a measure of frequency. The relationship of resonant circuit characteristics is illustrated by asymmetric time response curves. The asymmetry decreases as the parameter increases, and is negligible for parameter values where the distortion is large. As the parameter is increased, the maximum deficiency in the Fourier spectrum of the output voltage pulse occurs at a frequency closer to the resonant frequency. J.A.J.

N63-16020 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

BALLISTIC ANALYSIS OF MODULATED ELECTRON BEAMS Technical Report

I. Turkekul *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. II Oct. 30, 1962 100 p 13 refs (See N63-16016 13-09)
(Contract AF 30(602)-2573)
(Rept. 24; Res. Rept. EE-547)

This report describes a ballistic analysis made of an electron beam in a two-cavity klystron, which was assumed to have infinite cross section, negligible space charge, nonrelativistic velocities, and gridded finite gaps. The operating parameters of a catcher gap for maximum efficiency and the velocity-filtering capabilities of a rf gap interacting with a spent beam, at large signals were investigated. The term "velocity-filtering" means a reduction in the velocity of bunched electrons of a certain velocity-class. All the characteristics in this study were computed by a Burroughs Datatron-220 digital computer, when necessary. Author

N63-16021 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

REDUCTION OF SPURIOUS-OUTPUT SIGNALS IN HIGH-POWER KLYSTRONS Interim Report

A. R. Howland, Jr. *In its* Theoretical and Experimental Investigations of Linear Beam Microwave Tubes Final Report, Vol. II Sept. 20, 1962 24 p 4 refs (See N63-16016 13-09)
(Contract AF 30(602)-2573)
(Res. Rept. EE-540)

This report describes the study of a particular radiofrequency interference problem. The objective of this work is to develop and verify by experiment a design technique for a high-power klystron with reduced harmonic output. The work has three aspects: (1) an approach for a solution to a rf compatibility problem, (2) the test system, and (3) measurements of spurious-output signals. The approach followed to develop the design information is obtained by considering the higher-order modes present in the output cavity and placing these mode resonances systematically at optimum frequencies. The test system is constructed from a high-power radar transmitter transmission line and includes a sampling system with a higher-order mode. Measurements will be made on the second, third, and fourth harmonics of an unmodified and a modified klystron to determine the effectiveness of reducing the harmonically related spurious-output signals experimentally. Author

N63-16029 Watkins Johnson Co., Palo Alto, Calif.

Monthly Technical Progress Report No. 16, March 1 through March 31, 1963 [DEVELOPMENT OF A GRIDDED 100 KW L-BAND AMPLIFIER FOR USE IN PHASED-ARRAY RADAR SYSTEMS]

O. Thomas Purl Apr. 10, 1963 18 p
(Contract AF 19(628)-500)
(W-J 63-434R16)

Program objective is to develop a gridded 100 kw L-band amplifier that is suitable for application in phased-array radar systems. A single-reversal magnet gave 93% transmission with no drive and 75% transmission with 12 amps total beam current. Power output was about 1 to 2 db under 100 kw and gain was 12.5 to 13.5 db over the band with 75% transmission and 12 amps beam current. To determine the beam transmission necessary for the tube to produce 1 kw of average power, the hot spot temperature of the ring-bar circuit was calculated. The supporting ceramics for the circuit are constructed of beryllia. D.E.R.

N63-16032 Boeing Co., Seattle, Wash.

CHARGE-CONTROL EQUIVALENT CIRCUIT FOR PREDICTING TRANSIENT RADIATION EFFECTS IN TRANSISTORS

D. S. Gage (Michigan State U.), Gordon H. Hanson (Wash. U., Seattle), C. R. Rosenberg, and R. S. Caldwell [Mar. 1963] 27 p 4 refs
(Contract AF 29(601)-5238)
(D2-90389)

A charge-control equivalent circuit is developed in detail which can be used with a computer to predict the time-dependent response of any transistor to a pulse of ionizing radiation. Operation of the equivalent circuit during saturation is also provided. Measurement procedures are described for each of the necessary parameters in the circuit and comparison with experimental flash X-ray data is presented. Use of this transistor representation is demonstrated for predicting the response of a complete transistorized amplifier circuit. Author

N63-16069 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF LINEAR-BEAM MICROWAVE TUBES Final Report, Volume I, Oct. 1, 1961 to Sept. 30, 1962

G. Conrad Dalman et al [1963] 212 p 35 refs
(Contract AF 30(602)-2573)
(Res. Rept. EE-555; RADC-TDR-63-1, Vol. I)

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2. AN INVESTIGATION OF THE LAMINARITY OF FLOW IN A MAGNETICALLY CONFINED ELECTRON BEAM D. D. Hallock 84 p 18 refs (See N63-16071 13-09)
3. ION EFFECTS IN A BRILLOUIN BEAM A. S. Gilmour, Jr. and D. D. Hallock 20 p 6 refs (See N63-16072 13-09)
4. CAVITY FIELD PLOTTER J. E. Goell 6 p 2 refs (See N63-16073 13-09)
5. INVESTIGATION OF THE EFFECTS OF DRIVING THE MIDDLE CAVITY OF A THREE-CAVITY KLYSTRON D. Reynolds 26 p (See N63-16074 13-09)

N63-16070 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

THE CURRENT DISTRIBUTIONS IN A VELOCITY-MODULATED BRILLOUIN-FOCUSED ELECTRON BEAM Technical Report

A. S. Gilmour, Jr., and L. F. Eastman *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. I Oct. 29, 1962 53 p 9 refs (See N63-16069 13-09)
(Contract AF 30(602)-2573)
(Rept. 23; Res. Rept. EE-546)

This report describes the radiofrequency current distributions in a Brillouin-focused electron beam that has been velocity-modulated by a gridless-gap cavity. The report gives a review of the small-signal theory of ideal Brillouin beams in addition to small- and large-signal experimental results. An approximation is made to predict the RF current contours in a Brillouin beam whose d.c. current-density profile resembles a trapezoid. The predictions of this theory are found to agree well with actual beam behavior in that both the thickness and the amplitude of the RF current density ring around the beam vary with the depth of modulation α when α is very small. For values of α above 0.1, the amplitude of the current-density ring becomes constant while the thickness of the ring continues to vary. Author

N63-16071 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

AN INVESTIGATION OF THE LAMINARITY OF FLOW IN A MAGNETICALLY CONFINED ELECTRON BEAM Technical Report

D. D. Hallock *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Volume I Sept. 15, 1962 84 p 18 refs (See N63-16069 13-09)
(Contract AF 30(602)-2573)
(Rept. 19; Res. Rept. EE-539)

A study of the electron flow in a Brillouin beam was made, which yielded information that provided an insight into the electron behavior in a medium-power Brillouin beam. It was shown that the beam can display a high degree of laminarity at a beam voltage of 5000. The trajectory equation of the outer edge electron in the laminar model of the beam was linearized and shown to give results in good agreement with the experimental observations, when the focusing field was less than twice the Brillouin field. It was also shown that the beam can be focused at the calculated Brillouin field within the limits of experimental error. The differences between the theoretical predictions and the experimental observations, which arose from limitations either of the experimental apparatus or the theory, are discussed. The effects of thermal velocities are considered, particularly at low beam voltages. Author

N63-16072 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

ION EFFECTS IN A BRILLOUIN BEAM Technical Report

A. S. Gilmour, Jr., and D. D. Hallock *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. I Oct. 20, 1962 20 p 6 refs (See N63-16069 13-09)
(Contract AF 30(602)-2573)
(Rept. 22; Res. Rept. EE-545)

This report describes some of the effects of ion neutralization of the space charge in a Brillouin beam noted while making d.c. and RF current measurements with an electron-beam analyzer. Ion neutralization made the beam behavior depart from the ideal Brillouin behavior, resulting in a difference between theory and experiment. As ion neutralization was reduced, the experimental observations approached the theoretical predictions more closely. Ion neutralization was observed by injecting gas into the beam analyzer, on which the measurements were made, and observing the change in beam shape by measuring the current density at various points in the beam on an oscilloscope and an x-y recorder. The beam shape changed during the cathode pulse, indicating a buildup of ions, the rate of ion formation being a linear function of time during the pulse and varying with pressure. The presence and formation of ions in the beam seemed to increase the degree of nonlaminarity of flow. Author

N63-16073 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

CAVITY FIELD PLOTTER Interim Report

J. E. Goell *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. I Oct. 30, 1962 6 p 2 refs (See N63-16069 13-09)
(Contract AF 30(602)-2573)
(Res. Rept. EE-551)

An automated field-plotting system, using perturbation techniques, is described which obtains curves of electric field strength versus position within a resonant cavity. This system will make it possible to obtain accurate and detailed field plots of the fields in complicated structures. The operation is based on the shift in resonance frequency of a cavity that occurs when a dielectric, or conductor, is introduced within it. The circuit that has been built produces an output voltage which is proportional to shifts in the resonant frequency. This output voltage is plotted versus position by an x-y recorder. The accuracy of the system is limited to the accuracy of calibration. The calibration system reads to within ± 4 kc/s of the resonance frequency. Since two points are needed for calibration, the system is accurate to within ± 8 kc/s. Under reasonable conditions of bead and cavity size, shifts of 200 kc/s may be expected. If the system is calibrated on the extremes of the pattern, it will be accurate to within ± 4 percent. I.v.L.

N63-16074 Cornell U. School of Electrical Engineering, Ithaca, N.Y.

INVESTIGATION OF THE EFFECTS OF DRIVING THE MIDDLE CAVITY OF A THREE-CAVITY KLYSTRON Interim Report

D. Reynolds *In its* Theoretical and Experimental Investigation of Linear Beam Microwave Tubes Final Report, Vol. I Oct. 15, 1962 26 p (See N63-16069 13-09)
(Contract AF 30(602)-2573)
(Res. Rept. EE-544)

This report describes an experimental and theoretical investigation of the effects of driving the middle cavity of a three-cavity klystron. It indicates that drive power levels within a few decibels of the power output of the tube increase the total power output or efficiency no more than proper tuning of the middle cavity. Included are preliminary results of a theoretical study based upon a combination of space-charge waves and first-order ballistic theory. Author

N63-16107 General Electric Co. Cathode Ray Tube Dept., Syracuse, N.Y.
STUDY OF ELECTRON FOCUSING BY NON-LINEAR SPIRALS [Final Report, June 1959-Oct. 1961]
Kurt Schlesinger Wright-Patterson AFB, Ohio, Electronic Technology Lab., Oct. 1962 198 p 38 refs
(Contract AF 33(616)-6593)
(TIS-R62-ETC2; ASD-TDR-62-163; AD-291773)

The use of resistive spiral coatings in electron optical devices is discussed. These include spirals with uniform, as well as non-uniform, turn density. The linear spirals control electron optical throw without focusing. Nonlinear spirals can be used as electron lenses of the converging, as well as diverging, type. A general theory called Electron Trigonometry is developed to predict image formation in systems with spiral optics. This theory is also applicable to conventional systems employing electrostatic, magnetic, or mixed fields. Practical applications of spiral optics are illustrated by four types of developmental cathode ray tubes. Exploratory experiments are reported. Author

N63-16110 Radio Corp. of America., Semiconductor and Materials Div., Somerville, N.J.
DEVELOPMENT OF HIGH TEMPERATURE SEMICONDUCTOR DEVICES [Final Report, May 1958-July 1962]
H. Becke, W. A. Rosenberg, N. Ditrick, and F. L. Vogel Wright-Patterson AFB, Ohio, Electronic Technology Lab., Feb. 1963 121 p 12 refs
(Contract AF 33(600)-37267)
(ASD-TDR-63-59)

Gallium arsenide was chosen as the semiconductor material best suited to meet the needs of high-temperature operation because of its wide band gap and high electron mobility. A number of different devices were developed. These include: switching diodes, low-power rectifiers, medium-power rectifiers, high-power rectifiers, zener diodes, tunnel diodes, unipolar transistors, switching transistors, power transistors, and solid ceramic circuits. Of these the most successful were tunnel diodes and varactor diodes, since they are able to fulfill the requirements of some specific applications not filled by similar germanium and silicon devices. Author

N63-16150 Syracuse U. Research Inst., N.Y.
SENSITIVITY CONSIDERATIONS IN ACTIVE NETWORK SYNTHESIS Scientific Report No. 1
Norman Balabanian Apr. 1, 1963 50 p 6 refs
(Contract AF 19(628)-1649)
(SURI-EE-975-6304SR1; AFCRL-63-91)

This report is concerned with the problem of realization of active RC networks, utilizing practical transistor amplifiers, with minimum sensitivity of the transfer function or poles to variations in transistor parameters, in particular to the most variable of the parameters. Two synthesis techniques are considered and realizability conditions are given for single-stage and two-stage realizations. It is shown that the sensitivity of the poles to the variation of transistor α can be made as small as desired. Author

N63-16158 Naval Research Lab., Washington, D.C.
ADAPTATION OF TUNNEL DIODE STATIC INVERTER TO HIGHER INPUT VOLTAGES
J. M. Marzolf June 15, 1962 7 p 1 ref
(NRL-5802) OTS: $0.50

The basic tunnel-diode static inverter employing a single tunnel diode in each loop operates at approximately 0.25 volt d.c. input and is applicable with thermoelectric and solar-cell power supplies. Two or more tunnel diodes in series in each loop have been used with an external triggering circuit to accept higher input voltages. This development makes the tunnel-diode static inverter compatible with thermionic and fuel-cell generators, whose optimum output voltage is apparently in the range 0.75 to 1 volt, and is the only practical method at the present time of stepping up such low-voltage d.c. power sources. Author

N63-16165 Ampex Corp., Redwood City, Calif.
A VELOCITY CONTROL SYSTEM (TWO BACK-TO-BACK SPLIT-PHASE MOTORS)
Dushan Gasich Mar. 1963 57 p
(TR-63-1)

This report describes a novel velocity-control system for tape recorders, in which two split-phase induction motors with opposite directions of rotation are mounted on the same shaft to achieve effective torque increase as well as decrease. The electrical control system for the motors is described, operation of the system is analyzed, and recommendations for improvements are made. Author

N63-16220 Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRINTED CIRCUITS AND WELDED MODULES: AN ANNOTATED BIBLIOGRAPHY (1962)
J. B. Goldmann, comp. May 1963 82 p 203 refs
(SB-63-17)

This bibliography is a continuation of SB-62-5, *Printed Circuits and Welded Modules: An Annotated Bibliography*, April 1962. Microminiaturization of circuits and components as it is applied to manufacturing research, design standards and procedures, production methods and techniques and applications of the fabricated items were the subjects for which information was sought. This volume includes printed materials which were released during 1962. Author

N63-16281 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.
PRECISION TIME OR FREQUENCY TRANSMISSION TO MOVING VEHICLES Research Report
Richard M. Waetjen Apr. 1963 21 p 3 refs
(AFCRL-63-93)

A circuit is described which is capable of transmitting the output of an ultrastable oscillator or clock with an extremely high degree of accuracy to a moving vehicle. First-order Doppler frequency shift of the form fv/c, as caused by the velocity of the vehicle relative to the transmitting station, is cancelled, while second-order Doppler of the form fv^2/c^2 is largely eliminated. Because of these features, the circuit makes application of very stable frequency sources to vehicle electronic systems possible to degrees of stability which could previously not be achieved or even approached by several orders of magnitude. Applications of the circuit include radio navigation, guidance, and tracking, as well as data transmission, telemetry, and possibly communications involving earth satellites, moon satellites, and interplanetary and other space vehicles. Author

N63-16308 ITT Industrial Labs., Fort Wayne, Ind.
INVESTIGATION OF CLOSE-SPACED THERMIONIC CONVERTER [Final Report, Dec. 15, 1960-June 25, 1962]
Donald K. Coles Wright-Patterson AFB, Directorate of Aeromechanics, Oct. 1962 87 p 12 refs
(Contract AF 33(616)-7683)
(ASD-TDR-62-687)

Difficulties in realizing a very small anode–cathode spacing, due to uneven thermal expansion and warping, have led to a feasibility study of a subliming anode surface that automatically maintains the proper spacing from the cathode. Barium was chosen as a subliming metal since it serves also to activate the cathode. This required that all parts of the vacuum enclosure be held above 500° C. Effects of barium corrosion at high temperatures were studied. Four test models were made and tested. By holding the

temperature of the barium reservoir constant and varying the cathode temperature, the maximum of the Taylor–Langmuir emission S-curve was repeatedly traversed. Starting with an anode–cathode spacing of 0.007 inch and a heated barium reservoir, the spacing was reduced by buildup of barium on the anode. A metallic connection between anode and cathode then developed. This was removed by raising the cathode above 1000° C and the anode above 500° C. The characteristic thermionic current-voltage curves were then seen again, but with currents 12 times larger than those obtainable with the original spacing. This proved that buildup of barium had reduced the anode–cathode spacing. The highest power output observed was 0.28 amperes/cm^2 at 0.7 volt. Since the temperature distribution in the anode was nonoptimum, suggestions are made for further studies with improved anode design.
Author

N63-16330 Cutler-Hammer, Inc. Airborne Instruments Lab., Deer Park, N. Y.
INTERFERENCE ANALYSIS OF NEW COMPONENTS AND CIRCUIT TECHNIQUES, VOLUME II Final Report
S. Becker, J. W. Aichroth, F. G. Haneman, P. Kalisiak, J. F. Lyons, L. M. Orloff, and M. L. Wright May 1962 204 p 55 refs
(Contract AF 30(602)-2384)
(Rept. 8899-1; RADC-TDR-62-221)

The interference characteristics of transistors, ferrite devices, and crystal mixers are assessed. The resulting data are presented (1) to aid in the design of components and circuits which will not need interference suppressors, and (2) to guide design changes in existing equipment with interference problems. Transistor amplifier interference characteristics such as desensitization, cross modulation, and intermodulation are discussed, and the effects of transistor biasing and feedback on these characteristics are evaluated. The properties and applications of linear and nonlinear ferrite devices are discussed. An intermodulation analysis of crystal mixers is presented in which the magnitudes of input signals at undesired frequencies that will provide a given output are compared with signal inputs that produce the same output for the primary response. The resulting information can be used to predict spurious responses in mixers, determine the necessary filtering in receivers using mixers, and determine what intermodulation will result from changing diodes or adjusting the local oscillator level. M.P.G.

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-15780 Los Alamos Scientific Lab., N. Mex.
QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING MARCH 20, 1963
Apr. 1963 22 p
(Contract W-7405-eng-36)
(LAMS-2894) OTS: $0.50

Progress in construction of the reactor facility and mechanical assembly building is reported. Various components and systems are being tested and evaluated for use in the reactor facility.
N.E.A.

N63-15804 Melpar, Inc., Falls Church, Va.
DESIGN STUDY FOR VFS-2, VOLUME I Final Technical Report
J. E. Conant Sept. 1962 212 p
(NASA Contract NAS4-231)
(SS-1211) OTS: $14.50 ph, $6.56 mf

A design study was made for visual flight simulation and several recommendations were made, the most important of which was the multichannel television concept. Other recommendations were made in regard to 180° camera and projector optics, 180° projector display system, screen projection, infinity viewing system, and data storage.
J.A.J.

N63-15884 Pacific Missile Range, Point Mugu, Calif.
PACIFIC MISSILE RANGE MANUAL. VOLUME I: INTRODUCTION TO THE PACIFIC MISSILE RANGE
May 24, 1962 28 p
(PMR-MP-60-7)

A brief description is given of the Pacific Missile Range including the West Coast and island facilities and the missile range ships and aircraft.
R.C.M.

N63-15887 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho
ORGANIC CAPSULE IRRADIATION IN THE MTR RABBIT FACILITY
J. R. Mc Geachin and S. Cohen AEC National Reactor Testing Station, Mar. 1963 16 p 1 ref
(Contract AT(10-1)-205)
(IDO-16850) OTS: $0.50

Design criteria are given for the utilization of gamma heat to bring rabbit capsules to a desired temperature.
Author

N63-15919 Michigan U. Coll. of Engineering, Ann Arbor
PERFORMANCE COEFFICIENTS FOR POWERED WHEELS IN SAND Final Progress Report
D. K. Kapur and E. T. Vincent Mar. 1962 56 p 4 refs
(Contract DA-20-018-ORD-18955)
(Rept. 02860-36-F)

This report covers experimental results obtained to demonstrate the usefulness of similitude studies for soil-vehicle analysis when employing rigid powered wheels in a friction material such as dry sand. A range of load coefficients, wheel diameters, aspect ratios, and wheel slip from −100% to +100% were covered in the tests. Satisfactory dimensionless parameters existed over the range of sizes covered for load, sinkage, torque, and draw-bar coefficients.
Author

N63-15937 Argonne National Lab., Ill.
SAFETY ANALYSIS REPORT, EBR-I, MARK IV
R. O. Haroldsen, F. D. Mc Ginnis, M. Novick, R. R. Smith and F. W. Thalgott Feb. 1963 155 p 41 refs
(Contract W-31-109-eng-38)
(ANL-6411)

The hazards associated with operating the Experimental Breeder Reactor (EBR-1) with a metallic plutonium fuel core (Mark IV) are assessed. The potential hazards considered include not only those associated with usual reactor operations, but those peculiar to plutonium because of its low melting point, tendency to deform under stress, toxicity, and small value for its delayed neutron fraction. The results of this safety analysis indicate that safety mechanisms incorporated in this reactor facility are adequate for any foreseen credible accident.
M.P.G.

N63-15949 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

WHITE SANDS MISSILE RANGE CLIMATE CALENDAR

Paul H. Taft May 1963 20 p

(ERDA-20)

Mean daily maximum and minimum temperatures and extremes for the period of record (1950 to 1962) are tabulated in calendar form for the weather station located at Headquarters, White Sands Missile Range, New Mexico. Averages of temperature, relative humidity, precipitation, wind, and cloudiness are included for each month. Weekly means of maximum and minimum temperatures, as well as weekly values of precipitation, are presented in graph form. Author

N63-15971 Electro-Optical Systems, Inc., Pasadena, Calif.

ANALYSIS, FABRICATION AND TEST OF LARGE SOLAR CONCENTRATORS Quarterly Progress Report No. 4

Lee M. Springer Mar. 10, 1963 22 p

(Contract AF 33(616)-8402)

(EOS-1860-Q-4)

The current program is devoted to the design, fabrication, and preliminary testing of an all-metal petal of a 44 1/2-foot-diameter mirror. During this period, plating facilities were completed and checked for leaks with water and plating solution. The reflective inserts in the front-face master were completed. The polishable plastic surface of the large petal master has been proven experimentally by the model front-face reflective master which showed the practicality of such a system. A front-face skin was plated on the front-face master. It is now in the process of having the backing structure mold attached. A backing structure mold of plastic block foam was fabricated during this contract. The optical testing gear has been designed and is now in the process of assembly. A physical testing fixture has been designed and built. N.E.A.

N63-15978 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PRELAUNCH READINESS OF SPACE VEHICLES

Robert L. Smith, Jr. *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 25–41 (See N63-15976 13-01)

The methods and principles of providing for flight readiness of space vehicles are reviewed. It is found that the amount and type of preflight testing depends both on the vehicle and the mission, therefore the types of space missions are outlined as: manned orbital, circumlunar, lunar landing, and unmanned orbital. Pretest requirements are listed as follows: testing of design qualification, flight qualification, reliability, quality control, inspection, component function, and failure reporting. Also discussed are: systems testing, simulation, and substitution; types of testing; thoroughness, integrity, and record-keeping in preflight testing. D.E.R.

N63-15981 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AUTOMATION IN ORBITAL AND SPACE MISSIONS

William L. Mitchell and Charles O. Brooks *In its* Peenemünde to Outer Space [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 95–105 (See N63-15976 13-01)

The automatic control of the processes necessary for completing a space mission or operation requirement is reviewed. It is indicated that automation made the space era possible; also, its uses in space applications are unlimited. D.E.R.

N63-15982 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ON THE THEORY OF OPTIMIZATION OF STEP ROCKETS

Harry O. Ruppe *In its* From Peenemunde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 107–119 10 refs (See N63-15976 13-01)

The criteria for which the ratio of payload over launch weight is maximized for a given mission are developed. Several methods to optimize the weight distribution and the step number of staged rocket vehicles are described, and the conclusions are that: (1) analytical methods are available to give a "first cut" to the solution, (2) an optimum step number exists with respect to the maximized payload capability of a vehicle, and (3) the maximizing of payload capability does not generally result in the most economical transport system. D.E.R.

N63-15996 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

FLIGHT SIMULATION OF ROCKETS AND SPACECRAFT

H. H. Hosenthien and J. Boehm *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 437–469 20 refs (See N63-15976 13-01)

The techniques and apparatus of flight simulation are discussed from an historical viewpoint, beginning with the development of German rocketry and projecting the simulation concept into the future. The differential equations governing a rocket's behavior are presented and the factors limiting the rocket's performance are listed. D.E.R.

N63-16011 Aberdeen Proving Ground. Ballistics Research Labs., Md.

THE RELATIONSHIP BETWEEN GEODESY AND ROCKETRY

Hellmut Schmid *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 769–774 3 refs (See N63-15976 13-01)

The requirements of both rocketry and geodesy for the establishment of a physically acceptable geometric model of the earth and its geophysical parameters are found to be similar. Therefore, close collaboration between the two sciences is recommended, not only in basic theoretical considerations but also in regard to measuring methods and equipment. Geodesy can be used to solve the trajectory and range problems of rocketry; and rocketry can contribute to geodetic knowledge by actively sponsoring ideal geodetic satellite programs and by supporting precision tracking methods development. M.P.G.

N63-16030 Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

ABWR PL-2 DESIGN REPORT [Quarterly Progress Report for period ending Sept. 30, 1960]

B. Gitlow and Varick Schwartz Wash., D. C., AEC Div. of Tech. Information, Oct. 15, 1960 212 p

(Contracts AT(10-1)-967) and DA-44-192-ENG-11)

(IDO-19021, Vol. I) OTS: $7.00 for Vols. I and II

The design and operation of the PL-2 boiling water power reactor is described. This reactor, designed to deliver 1000 kw of net electrical power and 1,365,000 BTU/hr of net thermal power, uses modular construction to minimize field erection. All modules can be transported by CI30A aircraft and are suitable for all types of surface transport. The installation of the PL-2 in a snow tunnel is described; however, the plant is also suitable for installation at ambient temperatures up to 60° F and does not require a source of cooling water. The PL-2 is also designed for continuous operation for three full power years, based on conservative, proven power reactor techniques. M.P.G.

N63-16067 Lessells and Associates, Inc., Boston, Mass.
MECHANICAL TESTING TO 6000°F Sixth Progress Report, May 1,-Aug. 1, 1962
R. F. Brodrick, D. J. Fritch, and B. P. Friesecke Sept. 1, 1962 11 p
(Contract AF 33(616)-7554)

The electron-beam heat source for a testing facility capable of measuring the mechanical properties of materials in vacuum at temperatures from 2000° to 6000° F has been refined. The modifications of the electron guns and power source were made to obtain greater component reliability and to minimize surface damage to the tungsten test specimens. The maximum uniform continuous temperature obtained in the facility to date is 5880° F. Experiments are being conducted to determine the adequacy of the present furnace system to heat flat specimens uniformly using two of the three electron guns, each active gun supplying an electron beam at an angle of 30° to the specimen surface normal. The shape of the beam sweep was altered in order to achieve uniform heating in the longitudinal direction. M.P.G.

N63-16124 Los Alamos Scientific Lab., N. Mex.
INTEGRAL NEUTRON AND GAMMA DOSE MEASUREMENTS ON THE KIWI B-1 REACTORS. PART I: KIWI B-1A PART II: KIWI B-1B
F. M. Cox et al Mar. 1963 79 p 13 refs
(Contract W-7405-eng-36)
(LA-2858) OTS: $2.00

This report is an evaluation of the direct radiations from the Kiwi B-1 reactors. Included in this report are integral measurements of gamma dose, neutron flux, and neutron dose, made on Experimental Plans 4, 5, 5A, and 6 + 6A of Kiwi B-1A, and Experimental Plans 2, 3, and 4 of Kiwi B-1B. Results were obtained from almost every instrumented station. Author

N63-16143 MB Associates, Walnut Creek, Calif.
DEVELOPMENT OF AN EXPLOSIVE SABOTING TECHNIQUE FOR LIGHT GAS GUNS [First] Progress Report
Apr. 15, 1962 24 p
(Contract Nonr-3618(00)(X); ARPA Order 70-61; Proj. Defender)

The feasibility of an explosive sabot for use in light-gas hypervelocity guns that fire into an evacuated range is being investigated. The sabot is designed to fit a 0.60-caliber bore and carry a spherical steel projectile. The sabot consist of two halves, split longitudinally, with a hollowed-out cavity that contains a small explosive charge with an appropriate initiation system. Upon firing the gun, the explosive charge is detonated, creating a very high pressure in the cavity, which causes the sabot halves to fly apart, thus separating from the projectile. The projectile is then free to travel down the range and strike a target without having the effects on the target obscured by parts of the sabot. The major problem is in initiating the explosive charge without causing the sabot halves to separate; another problem is in saboting a light-gas gun to carry a high projectile, such as steel, without the acceleration effects causing the projectile to damage the sabot. N.E.A.

N63-16147 Advisory Group for Aeronautical Research and Development, Paris (France)
AGARD WIND TUNNEL CALIBRATION MODELS (MAQUETTES DE L'AGARD POUR L'ETALLONAGE DES SOUFFLERIES) Specification 2
Sept. 1958 24 p In English and French

The specifications are given of a series of standard models which may be used for calibrating aerodynamic testing facilities. Included are models designed to be tested under various conditions. A suggested test program for each model is given along with information required for comparative purposes. Author

N63-16208 Air Force Dept., Washington, D.C.
STANDARD FUNCTIONAL CRITERIA FOR DESIGN AND OPERATION OF CLEAN ROOMS Technical Manual
Feb. 7, 1962 71 p
(T. O. 00-25-203)

Environmental control requirements, operating procedures, and personnel and material control requirements are prescribed for designing and maintaining clean rooms. The clean room is a laboratory or shop which incorporates the high standards of environmental control and cleanliness necessary to meet the exacting operations and tolerances during the repair, assembly, calibration, and test of precision instruments. Four classes of clean rooms are established, and dust monitoring procedures and personnel practices are prescribed. Air Force systems and components are classified according to the type of clean room environment required. M.P.G.

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-15768 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYDROMAGNETIC STAGNATION-POINT BOUNDARY LAYER WITH ARBITRARY PRESSURE GRADIENT AND MAGNETIC FIELD
Willis H. Braun Washington, NASA, May 1963 36 p 13 refs
(NASA TN-D-1703) OTS: $1.00

The series-expansion method of H. Görtler is applied to the two-dimensional stagnation flow about symmetric bodies with symmetric distributions of magnetic field. Numerical computations are presented from which skin friction and heat transfer can be calculated through third-order in a modified surface coordinate, provided the external velocity, magnetic field, and enthalpy are known. A small magnetic Reynolds number is assumed; the Prandtl number is taken to be unity. The three chosen values of an interaction parameter represent magnetic fields in which the component normal to the wall has values at the stagnation point that are zero, small, and large. Author

N63-15781 New York U. Courant Inst. of Mathematical Sciences, N.Y.
THE INFLUENCE OF MOMENTUM EXCHANGE ON THE PROPAGATION OF DISTURBANCES IN A MULTI-COMPONENT FLUID
Richard L. Liboff Apr. 1, 1963 26 p 14 refs
(Contract AT(30-1)1480)
(MF-35; NYO-10428)

One-dimensional perturbations of a two-component neutral fluid about absolute Maxwellian equilibrium states (with equal temperatures) are examined. The starting equations are two Boltzmann equations coupled through difference-in-velocity terms. A Fourier–Laplace transform analysis indicates that the resulting modes are all strongly damped. It is concluded that a momentum exchange mechanism alone cannot support the collective sound mode. Asymptotic forms for decay frequency are found for small and large k waves. A thermodynamic estimate is given for the sound speed of a multi-component gas in which the number of degrees of freedom of each component is distinct. Author

N63-15807 Ohio State U. Aerodynamic Lab., Columbus

THEORY OF THE COMPRESSIBLE LAMINAR BOUNDARY LAYER UNDER ARBITRARY PRESSURE AND TEMPERATURE GRADIENTS [Final Report]

Theodore C. Nark Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 74 p 38 refs

(Contract AF 33(616)-7827)

(ASD-TDR-62-962)

An analysis is presented which can predict the compressible laminar boundary layer characteristics on a blunt, flat plate with prescribed surface temperature and pressure gradients. The analysis uses a Von Kármán integral method to solve the compressible momentum and energy equations. Problems usually encountered with very high pressure gradients are avoided by employing a new velocity profile which remains undistorted. A first-order analysis of the effect of entropy gradients in the inviscid flow on the boundary-layer parameters is also given. Author

N63-15813 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Spektroskopie und Molekularstrahlantriebe, Stuttgart (W. Germany)

[IMPULSE EXCHANGE BETWEEN GAS MOLECULES AT A SURFACE] IMPULSAUSTAUSCH VON GASMOLEKÜLEN AN OBERFLÄCHEN

H. Gienapp Mar. 1963 33 p 41 refs In GERMAN

(DVL-251) Available from Vereinigte Universitäts- u. Fachbuchhandlungen: R.-Wagner-Str. 1, Cologne, W. Germany

Research concerning boundary-layer phenomena of molecular aerodynamics requires an investigation of energy and impulse exchanges of gas molecules on solid and liquid surfaces. This paper presents the most important source material on this subject as well as a bibliography of present research work in this field. Trans. by I.v.L.

N63-15853 Purdue U. School of Aeronautical and Engineering Sciences, Lafayette, Ind.

THEORY OF THE THERMAL ACCOMMODATION COEFFICIENT

P. Feuer Dec. 1962 26 p 8 refs

(A&ES-62-17)

A quantum-mechanical theory of the thermal accommodation coefficient is discussed for a diatomic gas whose molecules can possess internal energy of rotation as well as translational energy. Expressions are obtained for α_t, the accommodation coefficient associated with the change in translational energy of a beam of gas molecules upon reflection from a solid surface, and α_i, the accommodation coefficient associated with the change in internal energy of the gas molecules. Some general conclusions are drawn concerning α_t and α_i and their relation to each other. Author

N63-15882 Ohio State U. Aerodynamic Lab., Columbus

AN EXPERIMENTAL INVESTIGATION OF THE SURFACE PRESSURE AND THE LAMINAR BOUNDARY LAYER ON A BLUNT FLAT PLATE IN HYPERSONIC FLOW VOL. II. LAMINAR BOUNDARY LAYER PROFILE ON THE FLAT PLATE [Final Report, Jan. 1961-Aug. 1962]

G. M. Gregorek, T. C. Nark, and J. D. Lee Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 117 p 7 refs

(Contract AF 33(616)-7827)

(ASD-TDR-62-792, Vol. II)

The laminar boundary layer on unswept, 1/2-inch-thick, cylindrically-blunted flat plate was examined at Mach numbers of 7, 10, 12 and 14; at Reynolds numbers from 9000 to 21,300, based on the plate thickness; and at angles-of-attack of 0°, 10° (compression) and 15° (expansion). The layer was probed at three stations, S/D = 8, 16, and 22, using a pitot probe and a sonic-pneumatic total-temperature probe. The tests were conducted in the 12-inch continuous hypersonic wind tunnel of the Ohio State University Aerodynamic Laboratory. The two probe outputs, together with the static pressure at the wall, were processed through an analog computer and the results, i.e., Mach number, velocity, temperature, etc., are tabulated as functions of distance from the surface. Integrations were performed to obtain displacement and momentum thicknesses. Skin friction was also obtained, through the measurement of the velocity gradient at the wall. The results are presented in tabulated form, while typical data are plotted to illustrate the trends established by Mach number, Reynolds number, and angle-of-attack. Author

N63-15900 Aeroanutical Research Associates of Princeton, Inc., N.J.

EXAMINATION OF THE SOLUTIONS OF THE NAVIER-STOKES EQUATIONS FOR A CLASS OF THREE-DIMENSIONAL VORTICES. PART II: VELOCITY AND PRESSURE DISTRIBUTIONS FOR UNSTEADY MOTION

Coleman du P. Donaldson and Roger D. Sullivan Nov. 1962 25 p 3 refs

(Contract AF 49(638)-255)

(ARAP-50; AFOSR-TN-60-1227, Pt. II)

The incompressible flow inside a porous cylindrical tube, having steady radial inflow and rotating about its axis in a sinusoidal manner, is obtained through solution of the complete Navier-Stokes equations. The nature of the tangential velocity profiles that result, and the magnitudes of the mean pressure drop and the amplitude of the pressure fluctuations that are induced by the tangential velocities are discussed. Author

N63-15963 Polytechnic Inst. of Brooklyn, N.Y.

ON THE MIXING OF LAMINAR AND TURBULENT AXIALLY SYMMETRIC COMPRESSIBLE FLOWS

Gdalia Kleinstein Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 83 p 23 refs

(Contract AF 33(616)-7661)

(PIBAL-756)

A unified analysis to solve mixing problems involving momentum, energy, and mass transfer in both laminar and turbulent axially symmetric compressible flow is presented. The method is based on the linearization of the conservation equations in the plane of the von Mises variables while retaining the essential nonlinear nature of the equations in the physical plane. The application of this method to a laminar-flow problem is shown to be in good agreement with a numerical solution of the boundary-layer equations obtained by Pai. The application of this method to turbulent flow requires an expression for the eddy viscosity. Prandtl's formulation has been applied successfully to problems involving incompressible flow. To allow for compressibility effects, a possible modification of Prandtl's formulation, suggested by Ferri, is investigated. When this expression for eddy viscosity is introduced, the application of the present method to compressible turbulent flow yields analytical results which are in good agreement with available experimental data. Author

N63-16025 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

ENTROPY-LAYER THEORY FOR PRESSURE DISTRIBUTIONS IN HYPERSONIC FLOW (TASK 3.1, FLOW-FIELD ANALYSES—REST PROJECT)

E. P. Salathé Oct. 25, 1962 27 p 16 refs

(Contract AF 04(694)-239)

(RAD-TM-62-79)

A general method has been developed for calculating pressure distributions on two-dimensional and axisymmetric blunt-nosed slender bodies. The solutions have been programed for digital computation for the particular cases of blunted wedges and cones. A few specific distributions have been computed and compared with the method of characteristics. Author

N63-16033 Aro, Inc., Arnold Air Force Station, Tenn.

CRYOPUMPING OF 77°K NITROGEN AND ARGON ON 10-25°K SURFACES

J. A. Collins, Jr., and J. P. Dawson Arnold Engineering Development Center, May 1963 27 p 8 refs

(Contract AF 40(600)-1000)

(AEDC-TDR-63-51)

Results are presented on the first phase of an experimental program designed to study the effects of gas and cryosurface temperatures on the capture coefficient in cryopumping. Experimental pumping speeds and capture coefficients were obtained for 77° K nitrogen and argon on a spherical cryosurface with temperatures ranging from 10° K to 25° K. The capture coefficients for the two gases were found to follow exponential functions of the cryosurface temperature. These functions were found to be similar to the Boltzmann distribution law. Author

N63-16037 Naval Ordnance Test Station, China Lake, Calif.

THE EFFECT OF A ROTATING CYLINDER AT THE LEADING AND TRAILING EDGES OF A HYDROFOIL

John D. Brooks Apr. 1963 17 p 1 ref

(NOTS-TP-3036; NAVWEPS-8042)

An experimental investigation was conducted in the high-speed water tunnel at the California Institute of Technology on the lift, drag, and moment produced by a rotating cylinder in the leading and trailing edges of a hydrofoil. It was found that with the cylinder in the leading edge, only a small increase in lift was developed, whereas with the cylinder in the trailing edge, a much larger lift increase was noted. Author

N63-16065 Hydronautics, Inc., Rockville, Md.

LOW DRAG SUPERCAVITATING HYDROFOIL SECTIONS

Jakob Auslaender Apr. 1962 123 p 97 refs

(Contract NObs-78396)

(Tech. Rept. 001-7)

Existing theory and experimental information on the design and performance of two-dimensional, low-drag, supercavitating and fully ventilated hydrofoils is reviewed and summarized. The results of detailed calculations based on linearized cavity flow theory (neglecting gravity) at zero cavitation number are presented in the form of lift–cavity drag ratio vs. lift coefficient, and nondimensional bending modulus vs. lift coefficient of low-drag foils designed specifically for operation at depths of 1/21, 2, and 5 chords, as well as infinite depth. The design of foils for arbitrary depths, including methods of interpolation between depths for which detailed plots are available, is described. The necessary nonlinear corrections and the effect of finite cavitation number are discussed and evaluated. The theory is shown to be in good agreement with experimental information found in the literature. Author

N63-16145 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Turbulenzforschung, Berlin (W. Germany)

[ON THE THEORY OF HYDRODYNAMIC STABILITY OF PLANE AND AXIALLY-SYMMETRIC PARALLEL STREAMS] ZUR HYDRODYNAMISCHEN STABILITATSTHEORIE EBENER AND AXIALSYMMETRISCHER PARALLELSTROMUNGEN

H. Schade Oct. 1962 154 p 82 refs In German

(DVL-190)

A parallel flow is a flow with linear parallel streams wherein the velocity field can be represented by cartesian coordinates in the form $\tau = [O_1O_1\ W(X,Y)]$. If $W = W(x)$, the flow is a two-dimensional parallel flow; if $W = W(x^2 + y^2)$, the flow is an axisymmetrical parallel flow. This paper attempts to determine to what degree the linearized stability theory for two-dimensional parallel flow can be extended to cases of axisymmetrical parallel flow. The paper includes: (1) a complete representation of the Tollmien-Schlichting-Lin Theory for two-dimensional parallel flow; (2) a discussion of the stability of axisymmetrical parallel flow in the light of general disturbances as compared to three-dimensional disturbances and in the light of a single disturbance as compared to axisymmetrical disturbances; and (3) an appendix which gives a complete history of the stability theory for parallel flow.

Trans. by I.v.L.

N63-16162 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

NUMERICAL SOLUTION OF AXIALLY SYMMETRIC POISSON EQUATION: THEORY AND APPLICATION TO ION-THRUSTER ANALYSIS. APPENDIX C: IBM 7090 ION-THRUSTOR FORTRAN CODE AND BLOCK DIAGRAM.

Vladimir Hamza and Carl D. Bogart Washington, NASA, May 1963 59 p 4 refs

(NASA TN-D-1711) OTS: $1.50

The axially symmetric Poisson equation is solved for mixed boundary conditions by a method of successive approximations in which the differential equation is replaced by finite-difference equations. Properties of the resulting matrix are studied. The theory of "regular splittings" is applied together with the Cyclic Chebyshev Semi-Iterative Method to solve the matrix equation. Also included is a numerical example, solved on an IBM-7090 computer, for a hollow, cylindrical ion beam. Author

N63-16186 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC INTERACTION EFFECTS AHEAD OF RECTANGULAR SONIC JETS EXHAUSTING PERPENDICULARLY FROM A FLAT PLATE INTO A MACH NUMBER 6 FREE STREAM

David J. Romeo Washington, NASA, May 1963 30 p 9 refs

(NASA TN-D-1800) OTS: $0.75

The aerodynamic interaction effects ahead of a three-dimensional rectangular jet exhausting perpendicularly from a flat plate have been investigated at a free-stream Mach number of 6. The interaction pressure distribution ahead of the slot center line was similar to, and approached quantitatively, the results of a two-dimensional jet slot. The ratio of aerodynamic to reaction normal force was sizable and, in general, was largest at the smallest slot widths and largest jet pressure ratios. The aerodynamic normal-force coefficient was comparable to two-dimensional results if the ratio of slot span to slot width was kept above a value dictated by the slot width. This value increased rapidly as the slot width decreased. Author

N63-16193 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Mülheim an der Ruhr (W. Germany)

[LABORATORY PRODUCTION OF ARTIFICIAL FOG AND FOG DISPERSAL EQUIPMENT USING ELECTRIC FIELDS. PART II] LABORATORIUMS-MÄSSIGE HERSTELLUNG KÜNSTLICHER NEBEL UND ENTNEBELUNGSVERSUCHE UNTER VERWENDUNG ELEKTRISCHER FELDER. TEIL II

U. Schmieschek Apr. 1963 49 p 2 refs In German

(DVL-206)

A laboratory installation was constructed for the production of steady and flowing fog so that the mechanics of fog formation could be investigated. This installation operates on the principle of a cold air and water vapor mixture. Testing of the installation showed that, at all times, reproducible fog of excellent stability in regard to density, flow velocity, and temperature can be produced. Investigations of the fog produced indicate that the average droplet radius is of the same order of magnitude as the average droplet radius of natural fog. The quantitative density of various fogs was determined by an absorption method. A fog dispersion installation was equipped with an electro-optical apparatus and a visibility metering device for the purpose of rapid determination of the prevailing fog

density. Fog dispersal investigations were carried out with the aid of steady and alternating electric fields. In each investigation, the degree of fog dispersal was quantitatively determined. In these investigations, the dependency of the degree of fog dispersal upon the characteristics and the position of the electric fields was determined. In addition, the degree of fog dispersal as a function of the prevailing strength of the electric field, the fog density, and the flow velocity was investigated. Results of this investigation indicate that the use of a steady electric field for fog dispersal is practically useless. On the other hand, the use of an alternating electric field produces excellent fog dispersal effects; a fog dispersal of 75 percent was obtained. Trans. by I.v.L.

N63-16225 Virginia U., Charlottesville
A COMPARISON OF THE THEORETICAL AND EXPERIMENTAL STAGNATION POINT HEAT TRANSFER IN A HIGH-TEMPERATURE SUBSONIC STREAM
Ronald D. Brown (M.S. Thesis) June 1963 44 p 18 refs

The laminar-flow subsonic stagnation-point heat transfer is evaluated by using a potential-flow velocity gradient that can be applied to any subsonic high-temperature facility. Stagnation-point heat-transfer measurements were made on three flat-face cylinders of different diameters and a three-inch-diameter hemisphere cylinder in the six-inch subsonic arc tunnel at the Langley Research Center. The free-stream temperature, the free-stream pressures, the stagnation-point heat-transfer rates, and heat-transfer distributions were determined at several operating conditions. An empirical heat-transfer relationship is derived from the experimental data and a discussion of the blocking and Mach number effects on the potential-flow velocity gradients is presented. Results indicate that the stagnation-point heat-transfer measurements on flat-face cylinders in the six-inch subsonic arc tunnel do not follow the laminar heat-transfer theory of Fay and Riddell or Van Driest in the Reynolds number range covered in this report. It was concluded that the difference between theory and experiment is not a function of stagnation-point velocity-gradient variation because of compressibility or blocking effects. The deviation from laminar-flow theory is attributed to the turbulent state of the gas, caused by the electric arcs in the arc chamber of the subsonic arc tunnel. I.v.L.

N63-16272 Guggenheim Labs. for the Aerospace Propulsion Sciences, Princeton U., N. J.
THE DEGREE OF APPROACH TO EQUILIBRIUM IN AN ATMOSPHERIC-PRESSURE ARCJET USING ARGON
Martin P. Sherman Apr. 1963 25 p 16 refs
(Contract AF 33(657)-9962)
(Aeronautical Eng. Rept. 645)

The question of whether an argon plasma, generated in a plasma jet under certain conditions, is in equilibrium as it leaves the nozzle of the jet, and whether it remains in equilibrium as it rapidly cools in the mixing region, is considered here. The flow is at low subsonic Mach numbers and therefore at ambient pressure (in this case atmospheric); and the peak temperature of the jet is 14,000° K. Both turbulent and laminar flows are considered. The criteria for equilibrium are that: the mole fractions of argon neutrals, ions, and electrons are near equilibrium; electron and ion temperatures are fairly close; and the excited state populations are near equilibrium. It is found that the plasma does approach the equilibrium state according to the above criteria, especially that of the electron and ion temperatures being similar. D.E.R.

N63-16278 Deutsche Versuchsanstalt für Luft-und Raumfahrt. Inst. für Angewandte Mathematik und Mechanik, Freiburg (W. Germany)
[ON THE PROBLEMS OF PARAMETER-DEPENDENT PROGRAMMING] ÜBER PROBLEME PARAMETERABHANGIGER PLANUNGSRECHNUNG
K. Ritter Apr. 1963 105 p 9 refs In German
(DVL-238)

The subject of this work is the treatment of the dependent parameter maximum problems. The objective is to present the explicit solution of the function of the parameters. To this end, a process is evolved that permits the presupposition of the specific parameter interval; therefore, as a result many intervals are proportioned. In each partial report, a parameter-dependent set of equations is arranged, so that the solution is in agreement with the optimum solution. For maximum problems with quadratic objective functions and linear secondary conditions, these sets of equations are linear. The expansion gives the components of optimum solutions in the form of the quotient formed from the polynomial of the parameters. Through an application of this process, one can obtain a method for solving quadratic maximum problems with severe concave objective functions and linear secondary conditions.
Trans. by J.A.J.

N63-16325 California U., Los Angeles. Aerosonics Lab.
MECHANISMS OF AERODYNAMIC SOUND PRODUCTION
Alan Powell [1962] 12 p 21 refs Presented at the AGARD, Meeting of "The Mechanism of Noise Generation in Turbulent Flow", Brussels, Apr. 1-4, 1963

A viewpoint of use in studies of flow instability is that the incompressible flow field is induced by the vorticity. This classical viewpoint can be generalized to the compressible flow field; then, the flow field induced by the vorticity automatically includes the radiated sound field. Using spinning vortices as a simple model, it is shown how the vortex motion enables the distant sound pressure to be estimated directly. Alternatively, the hydrodynamic near field can be estimated on an enveloping surface, whose motion can be considered to drive the sound field. The sound power depends on the eighth power of the flow velocity. Expanding vortex rings are directly associated with the dipole field of aeolian and edge tones. In the latter case, the vortex motion also reacts on the unstable jet flow itself, causing a selective feedback which, together with the instability characteristic, gives rise to the distinctive frequency characteristics. Measurements confirm that the sound source is of the dipole type with the acoustic power depending on the jet velocity raised to the sixth power. If a resonant cavity is added to a feedback system, such as the edgetone, the action may be dominated by the acoustic resonant feedback; then, both theory and experiment show that the sound power at low speeds is dependent on about the fourth power of the jet velocity. The whole action remains dominated by the instability characteristics of the jet flow. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: **28 Space Radiation.**

For related information see: **05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.**

N63-15791 Cornell U. Agricultural Research Service, Ithaca, N.Y.
THE ENERGY BUDGET AT THE EARTH'S SURFACE SOIL MOISTURE ANALYSES, ELLIS HOLLOW, (ITHACA, N.Y.) 1960 AND 1961
J. H. Shinn, K. W. Brown, and R. F. West Sept. 1962 56 p
(USAEPG Cross Service Order 2-62)
(Interim Rept. 62-6; Res. Rept. 357)

This report is a summary of soil-moisture data taken in connection with an energy balance and evapotranspiration study during 1960 and 1961 in fields of corn and alfalfa at Ithaca, N.Y. Soil-moisture measurements were made in the laboratory on undisturbed core samples, using the pressure-plate apparatus, and measurements were made in the field using tensiometers and the neutron probe. Author

N63-15819 Smithsonian Astrophysical Observatory, Cambridge, Mass.

VARIATIONS IN THE EARTH'S UPPER ATMOSPHERE AS REVEALED BY SATELLITE DRAG

Luigi G. Jacchia Dec. 31, 1962 65 p 91 refs

Temperature and density variations in the Earth's upper atmosphere are revealed by the atmospheric drag on satellite orbits. Since the atmospheric drag can be separated from the other perturbing forces, it is possible to compute the nighttime minimum temperature of the upper atmosphere from which the temperature at any other point of the earth can be derived. This is done by compensating for 27 day oscillations, solar flux, diurnal bulge, and geomagnetic effect. J.A.J.

N63-15855 Bundesministerium für Verkehr, Bonn (W. Germany)

UNTERSUCHUNG VON LUFTSTRÖMUNGEN IM ALPENVORRAUM [INVESTIGATION OF AIR CURRENTS IN THE ALPINE FOOTHILLS]

R. Maletzke Düsseldorf, VDI-Verlag GmbH, 1962 29 p 56 refs In German

(*Its* Luftfahrt-Forschungsberichte 15)

Prevailing air currents at Alpine foothills are reviewed with the purpose of aiding sailplane pilots. This review includes: (1) methods for measuring winds at high altitudes, (2) the effects of meteorological conditions on the occurrence of valley winds, (3) the period of calm following wind-direction reversal in the morning, (4) the important characteristics of valley currents, (5) typical velocity profiles for valley and foothills, (6) a detailed investigation of the mechanism of flow in valley and foothill areas, (7) the influence of foothill currents on valley currents, and (8) the construction of velocity profiles for various points along the Alpine foothills. I.v.L.

N63-15869 National Physical Lab. Radio Propagation Unit, New Delhi (India)

IONOSPHERIC EFFECTS FOLLOWING DISTANT NUCLEAR DETONATIONS Scientific Report No. 10

A. K. Saha, Mirjana Karabin, and K. K. Mahajan Jan. 31, 1963 18 p 10 refs

(RPU-S-10)

The report describes preliminary results of observations made at Delhi of some ionospheric effects, recorded with different techniques, following Russian nuclear detonations in the megaton range, during August and September, 1962. The major effects observed were: a rise in foF2, observed with a C-4 ionosonde following a nuclear detonation, the peak of the enhancement occurring about 3 1/2 to 5 hours after detonation; enhancements on atmospheric noise levels at 27 kc/s and at 100 kc/s, and in the field strength of Radio Tashkent (164 kc/s), the peaks being generally around two hours after detonation. Cosmic radio-noise-absorption increases were also noted following some of the detonations. A reversal of the relative magnitudes of 27 kc/s and 100 kc/s effects were noted as compared to flare cases. Author

N63-15896 RAND Corp., Santa Monica, Calif.

DISSIPATION EFFECTS CONTROLLING THE ELECTRICAL MORPHOLOGY OF THE MESOSPHERE

P. A. Goldberg Apr. 1963 24 p 16 refs

(Contract AF 49(638)-700, Proj. RAND)

(RM-3585-PR)

Electrical dissipation in the mesosphere is dominated by gas particle collisions. Hence, the electrical properties of this region are controlled by the density of the atmosphere. For low-frequency propagation, the electromagnetic properties of the mesosphere can be described in terms of variations with altitude of the local complex refractive index. For the simple condition of excitation of the mesosphere by a single kind of ionizing radiation, the complex refractive index should have exponential-scale variation with altitude of less than 12 km for the lower mesosphere. Sudden onset of more complex conditions of excitation may "trigger" the mesosphere into a state of "shelving" or ducted structure in its electrical properties. Depending on the details of the excitation, such ducting will contain regions of negative gradients in the altitude variation of the electrical properties, instead of merely the position gradient with a 12-km upper limit. Author

N63-15943 Alaska U. Geophysical Inst., College

ON THE ASSOCIATION BETWEEN SUBVISUAL RED ARCS AND THE Dst (H) DECREASE

M. H. Rees (Colorado U.) and S. I. Akasofu London, Pergamon Press [1962] 3 p 11 refs Repr. from Planet. Space Sci., v. 11, 1963 p 105-107

(NASA Grant NsG-201-62; NSF G-14898)

The occurrence of subvisual red arcs during magnetic storms suggests a relationship with the storm time magnetic fields. It has been found, however, that a red arc does not show any changes when polar aurorae to the north break up with rapid and large fluctuations in intensity. The fluctuations are accompanied by polar magnetic storms that occur intermittently with a lifetime of about 2 to 3 hours. Evidently, there are some intrinsic differences between the midlatitude subvisual red arcs and the polar aurorae or red glows. The ring current field is the only storm time field which has a time constant similar to that of the red arc (about 10 hours or more). The red arcs occur during a magnetic storm with an appreciable main phase, and it is shown that their intensity is related to the magnitude of the Dst (H) decrease. N.E.A.

N63-15948 RAND Corp., Santa Monica, Calif.

THE RESPONSE TIME OF THE LOWER IONOSPHERE TO A PULSE OF IONIZATION

R. E. Le Levier Aug. 1962 43 p 9 refs

(Contract AF 49(638)-700; Proj. RAND)

(RM-3204-PR; AD-282-609)

This report presents a theoretical discussion of the response of the ionosphere to a pulse of ionization. The model for the air chemistry used here assumes a standard air mixture for which O_2^- is the dominant negative ion. Day and night environments are discussed. The recovery characteristics of X-ray-induced ionization from high-altitude nuclear explosions are considered. A suggestion is made for using a low-yield, high-altitude nuclear explosion as an X-ray source of known characteristics. This would permit the factoring of the properties of the ionosphere from those of the source. Author

N63-16023 Alaska U. Geophysical Inst., College

HIGH LATITUDE GEOPHYSICAL DATA, APRIL-JUNE, 1962

July 1962 13 p

(UAG-C-28)

Tables of high-latitude geophysical data are presented for April, May, and June 1962. The data include earth current amplitude activity, earth current fluctuations, ionospheric absorption of cosmic radio noise, and magnetic activity data for College, Alaska, as well as K-indices, whole-day character, and equivalent daily amplitude. M.P.G.

N63-16026 Alaska U. Geophysical Inst., College

HIGH LATITUDE GEOPHYSICAL DATA, JULY-SEPTEMBER 1962

V. P. Hessler, Harold Leinbach, M. Almasi, and R. Parthasarathy Nov. 1, 1962 20 p 4 refs

(UAG-C-29)

Methods of measurement and data obtained by these methods are presented for the following: (1) earth current amplitude activity, (2) earth current fluctuations, (3) ionospheric absorption of cosmic ray noise, and (4) magnetic activity. I.v.L.

N63-16044 National Physical Lab., New Delhi (India)
STUDIES OF EQUATORIAL F REGION Scientific Report No. 9
B. C. Narasinga Rao Dec. 1, 1962 41 p 21 refs
(RPU-S9)

The characteristic features of the equatorial F-region are studied using the published data. The study reveals some important differences in the equatorial anomaly in the Asian, African, and American zones. The location of the F-region equator is examined, and the results indicate that the F-region equator does not correspond exactly to the magnetic-dip equator, but is shifted slightly toward north in the Asian and American zones, and slightly toward south in the African zone. The diurnal variation of F-region critical frequency showed peculiar post-sunset rise in the transition region. This is found to depend on the solar activity and the characteristic post-sunset rise in the height of the equatorial F-region. Author

N63-16163 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ION SHEATH EFFECTS NEAR ANTENNAS RADIATING WITHIN THE IONOSPHERE
H. A. Whale Washington, NASA, May 1963 16 p 8 refs Submitted for Publication
(NASA TN-D-1746) OTS: $0.50

A theoretical treatment of the electron displacement in the vicinity of a linear cylindrical antenna immersed in the ionosphere has been developed. This treatment explains the surprisingly thick ion sheaths observed experimentally when large RF voltages are applied to the antenna. The force that displaces the electrons is obtained from numerical solutions to the nonlinear differential equation describing their motion, and the results are consistent with the observations. Author

N63-16202 Coast and Geodetic Survey, Washington, D.C.
PROJECT SEDAN. SEISMIC EFFECTS FROM A HIGH YIELD NUCLEAR CRATERING EXPERIMENT IN DESERT ALLUVIUM. PLOWSHARE PROGRAM Final Report
W. V. Mickey Feb. 1963 67 p 14 refs
(PNE-213F) OTS: $1.50

Sedan was a thermonuclear cratering experiment with a yield of about 100 kt detonated at a depth of 660 feet, and resulting in a crater of maximum apparent depth of 320 feet and average apparent diameter of about 1200 feet. About 7.5 million cubic yards of earth and rock were displaced. Transitory earth-particle motions were, on an average, twice as large from stations on deep alluvial deposits compared to those on shallow deposits at the same distance. Computed seismic energy was about 2.45×10^{18} ergs, equivalent to a local earthquake magnitude of 4.75. This indicates that .06 percent of the total source energy was converted to seismic energy. Frequency analysis revealed spectral peaks near 1 cps. Author

N63-16203 California U., Berkeley. Lawrence Radiation Lab.
SEISMIC VELOCITY STUDY. PLOWSHARE PROGRAM Final Report
S. E. Warner Nevada Test Site, AEC, May 15, 1963 51 p 3 refs
(Proj. Sedan)
(PNE-235F) OTS: $1.25

This series of experiments evaluates the performance of pressure-pulse transducers in determining distances of installed gages from small HE detonations by measuring seismic-wave travel times. Travel-time measurements used "satellite"-hole gage placements, 5-pound C-4 detonations near the planned location of the device in the device hole, and operational diagnostic facilities. The results verified the original premise of the suitability of Plowshare instrumentation to determine with superior accuracy installed gage distances from the small HE detonations. Agreement of within 1% between surveyed distances and calculated distances was obtained for the three gage locations reporting. Seismic velocities obtained fell between 3825 and 3875 feet per second. Also, the experiment demonstrated the integrity of the Plowshare instrumentation system as installed. Author

N63-16292 National Aeronautics and Space Administration, Washington, D.C.
THE EFFECT OF REFRACTION ON THE SETTING SUN AS SEEN FROM SPACE IN THEORY AND OBSERVATION
Winifred Sawtell Cameron, John H. Glenn, M. Scott Carpenter, and John A. O'Keefe May 1963 10 p 3 refs
(NASA TN-D-1721) OTS: $0.50

The theory of refraction predicts that the setting sun or moon, as seen from space, should be highly flattened. The Mercury Project Manned Space Flights MA-6 and MA-7 have provided photographs of the phenomenon. To compare theory with observation, B. Garfinkel's Method I of computing refraction for large zenith distances was used to construct theoretical solar profiles for four true-zenith distances of the center of the setting sun for comparison with the photographs taken by Glenn and Carpenter. Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-15784 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
STUDY OF INFRARED EMISSION FROM HYPERSONIC AIR FLOWS Semi-Annual Report
Walter H. Wurster and Paul V. Marrone Jan. 1962 51 p 11 refs (Contract DA-30-069-ORD-3443; ARPA Order 253-62 Proj Defender)
(CAL-QM-1626-A-2)

This report presents the results obtained through 31 December 1961 of a research program whose objective is to formulate a comprehensive picture of the infrared radiation from reentry bodies. The program is divided into two phases: the experimental determination of the radiative properties of the optically active gaseous species, and the analysis of the blunt-body flow field, in which the finite-rate chemistry of the air is coupled with the aerodynamics of the flow. Author

N63-15898 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham
ANALYSIS OF CRITERION RELATIONSHIPS FOR LIQUIDS BOILING IN TUBES (UTOCHENIE KRITERIAL'NYKH ZAVISIMOSTEI PRI KIPENII ZHIDKOSTEI V TRUBAKH)
I. I. Sagan' Apr. 1963 10 p 9 refs Transl. from Izvest. Vyssh. Ucheb. Zaved. Energ. (Minsk) (5), 1959 p 108–114
(TIL/T-5388)

Investigations made on boiling concentrated sugar solutions with natural circulation and interchangeable heating tubes gave results enabling a corrected criterion equation to be produced based on that of M.A. Kichigin and N. Y. Tobilevich. The use of this equation is advocated for heat-transfer conditions in boiling processes. Author

N63-15988 Minnesota U. Rosemount Aeronautical Labs., Minneapolis

EVAPORATIVE FILM COOLING FOR HYPERSONIC REENTRY VEHICLES

Rudolf Hermann (Alabama U.) *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 261-286 13 refs (See N63-15976 13-01)

(Contract AF 49(638)-190)

Research on liquid evaporative film cooling of hypersonic reentry vehicles is reported. A similarity analysis has been developed for laminar stagnation point flow that predicts the temperature and water vapor mass fraction at the gas-liquid interface, the local mass flux of evaporation, the coolant film thickness, and the velocity at the interface. An extension of the analysis to circular reentry conditions indicates that: (1) evaporative film cooling is thermodynamically feasible for typical reentry vehicles, (2) the vehicle skin and underlying structures are kept at low temperatures so as to avoid thermal stresses and the need for large internal cooling systems, and (3) the total coolant mass required compares favorably with the mass lost during ablation cooling. Other advantages include an unchanged aerodynamic shape throughout reentry, and improved radio communication. M.P.G.

N63-16051 Little (Arthur D.), Inc., Cambridge, Mass.

PROCEEDINGS OF [AFOSR] CONFERENCE ON AERODYNAMICALLY HEATED STRUCTURES, CAMBRIDGE, MASS., JULY 25, 1961

Peter E. Glaser, ed. Englewood Cliffs, N.J., Prentice-Hall, Inc., 1962 366 p 271 refs

(Jointly sponsored by AFOSR and Arthur D. Little, Inc.)

(AD-282454)

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7. HIGH-TEMPERATURE COMPOSITE STRUCTURAL CONFIGURATIONS: RADIATIVE THERMAL PROTECTION SYSTEMS FOR 2500° F TO 4500° F .R. D. Guyton (Aeronautical Systems Div.) p 151–170 (See N63-16058 13-34)
8. THE STATUS OF HEAT TRANSFER CONTROL BY MASS TRANSFER FOR PERMANENT SURFACE STRUCTURES B. M. Leadon (General Dynamics Corp.) p 171–196 149 refs (See N63-16059 13-13)
9. STRUCTURES FOR MANNED ENTRY VEHICLES R. R. Heldenfels (NASA. Langley Research Center) p 197–218 13 refs (See N63-16060 13-34)
10. THERMALLY INTEGRATED STRUCTURE: A REVIEW OF LOW-INTENSITY COOLING SYSTEMS FOR THERMALLY PROTECTED AIRFRAMES J. J. King, Jr. (Chance Vought Corp.) p 219–243 7 refs (For abstract see N62-16600 17-33)
11. ADVANCES IN HIGH-TEMPERATURE THERMAL PROTECTION SYSTEMS A. Wechsler (Little (Arthur D.), Inc.) p 245–263 (For abstract see N62-16604 17-18)
12. THERMAL PERFORMANCE OF RIGID INSULATIONS AT CRYOGENIC TEMPERATURES S. Speil (Johns-Manville Research Center) p 265–292 18 refs (See N63-16061 13-13)
13. CRYOGENIC-PROPELLANT HEATING IN THE THERMAL ENVIRONMENT OF SPACE G. R. Smolak and R. H. Knoll (NASA. Lewis Research Center) p 293–331 29 refs (See N63-16062 13-26)
14. DEVELOPMENT OF MATERIALS FOR THE THERMAL ENVIRONMENT W. J. Harris, Jr. (Battelle Mem. Inst.) p 333–343 (See N63-16063 13-17)
15. SUMMARY OF LOW-TEMPERATURE INSULATIONS H. O. McMahon (Little (Arthur D.), Inc.) p 347–349
16. SUMMARY OF COOL STRUCTURES W. H. Dukes (Bell Aerosystems Co.) p 351–354
17. SUMMARY OF HOT STRUCTURES E. G. Czarnecki (Boeing Co.) p 355–362

N63-16052 General Electric Co., Philadelphia, Pa.

THE OUTLOOK FOR ABLATING HEAT PROTECTION SYSTEMS

I. J. Gruntfest *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 1–6 2 refs (See N63-16051 13-13)

The state of the art of ablation heat protection systems is discussed and their future prospects are estimated. The whole complexion of the heat protection problem has changed but development of ablation materials is still in its infancy. The gasdynamic theory for laminar heat transfer and transpiration cooling is quite well advanced. The turbulent-flow situation still leaves much to be desired. The physical chemistry of the phenomena that occur in the ablating solid is known only in a general way. The understanding of the decomposition mechanism must be sharpened and translated into requirement terms for gross and molecular structure. In particular, to understand the chemistry and energy balance involved, attention must be given to the microscopic processes occurring in depth within the material. Organic materials, which give the most refractory surface material (carbon) and most efficient transpirational material (hydrogen), are likely to be of greatest interest in severe environments. In spite of the considerable achievement and promise of ablating systems, dimensional stability during flight is not among their virtues. N.E.A.

N63-16057 Little (Arthur D.), Inc., Cambridge, Mass.

FUNDAMENTAL LIMITATIONS OF MULTILAYERED RADIATION SHEILDS

A. G. Emslie *In its* Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 135–150 (See N63-16051 13-13)

(NASA Contract NAS5-664)

This paper examines the basic factors that limit the efficiency of multifoil radiation shields in the thermal protection of low-temperature liquids in space. Detailed calculations are given of the heat conduction by gas molecules and of the radiation transfer at close foil spacings. Author

N63-16059 General Dynamics Corp., San Diego, Calif.

THE STATUS OF HEAT TRANSFER CONTROL BY MASS TRANSFER FOR PERMANENT SURFACE STRUCTURES

Bernard M. Leadon *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 171–196 149 refs (See N63-16051 13-13)

The term "mass transfer" covers the entire material-injection cooling technique from transpiration to ablation. The discussion

relates to all mass-transfer cooling systems utilizing a permanent wall structure. The greatest amount of information is available in the case of simple transpiration, but nonhomogeneous systems have also been studied, especially with the injection of light and heavy gases and liquid water. Chemically reactive systems have received some theoretical but little experimental attention. Laminar boundary layers are also much better understood than are turbulent boundary layers, a circumstance which is, of course, traceable to the present state of knowledge, even without the complication of a porous wall. However, interesting results have recently been obtained for the injection of nitrogen into turbulent boundary layers. Author

N63-16061 Johns-Manville Research Center, Manville, N. J.
THERMAL PERFORMANCE OF RIGID INSULATIONS AT CRYOGENIC TEMPERATURES
S. Speil *In* Little (Arthur D.), Inc., Cambridge, Mass. Prod. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 265-292 18 refs (See N63-16051 13-13)

Background conductivity information is presented for commercially available rigid insulation and selected experimental media and the significance of these data in the light of anticipated future needs is reviewed. From general observations of thermal performance at atmospheric pressure, it was noted that: the conductivity of rigid porous materials increases with density, the conductivity of insulations is approximately the same as that of powder fills of the same density and basic raw material; and because most insulations do have higher density than conventional powder fills, they will be used primarily when their selection is indicated by strength requirements, ease of application, or cost considerations. Two future approaches for improvement in thermal performance of rigid insulation appear to be: preferential orientation of the structural elements so as to minimize conduction, and selection of basic materials with low intrinsic thermal conductivity in the solid phase. N.E.A.

N63-16153 Little (Arthur D.) Inc., Cambridge, Mass.
THERMAL CONDUCTIVITY OF NON-METALLIC MATERIALS Summary Report, 27 Mar. 1961-27 Apr. 1962
Anne Everest, Peter E. Glaser and Alfred E. Wechsler 1962 86 p 31 refs
(NASA Contract NAS8-1567)
OTS: $8.10 ph, $2.78 mf

This program encompassed both a theoretical and experimental investigation at low temperatures of the effect of variables such as gas pressure, boundary temperatures, type of gas, particle size, and bulk density, on the thermal conductivity of colloidal silica and perlite insulating powders. The sample powders were tested under various test conditions at several precentage combinations by weight to determine the effect of particle size on thermal conductivity. The test samples were exposed to five gas pressures. The thermal conductivity of the test samples was determined at densities ranging from 0.06 to 0.12gm/cu cm because the density yielding the lowest thermal conductivity was found to be in this range. The effect of boundary temperature on conductivity was determined for hot-plate temperatures ranging from 285° to 385° K and cold-plate temperatures from 77° to 232° K. A theoretical correlation of the available data was made to establish the effect on thermal conductivity of the variables given to supplement the experimental program. N.E.A.

N63-16184 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
RESPONSE OF CHARRING ABLATORS TO HYPERTHERMAL ENVIRONMENT
R. D. Mathieu Feb. 1963 37 p 21 refs
(Contract AF 04(647)-617)
(R63SD20)

A study is made of the thermal response of charring ablators to given environmental conditions. The heat-protective materials considered form gases and a porous char as they undergo thermal degradation in depth. The analysis considers the transient conditions and the effect of the surface pressure on the gas pressure buildup within the porous char. The effects of porosity and permeability are included. Results of the temperature, material density, and gas-pressure distribution through the heat-protective layer are presented for a typical charring material. Two cases are considered: in the first case, the material undergoes one degradation reaction; in the second case, the material undergoes two successive reactions. Author

N63-16241 National Advisory Committee for Aeronautics, Langley Aeronautical Lab., Langley Field, Va.
HEAT-TRANSFER MEASUREMENTS ON A CONCAVE HEMISPHERICAL NOSE SHAPE WITH UNSTEADY-FLOW EFFECTS AT MACH NUMBERS OF 1.98 AND 4.95
Morton Cooper, Ivan E. Beckwith, Jim J. Jones, and James J. Gallagher Washington, NACA, July 17, 1958 21 p 6 refs
(NACA RM-L58D25a) OTS: $2.60 ph, $0.83 mf (Declassified)

Heat-transfer rates and pressure fluctuations at Mach numbers of 1.98 and 4.95 have been measured at the stagnation point of a concave hemisphere for a Reynolds number range from 2×10^6 to 11×10^6, based on freestream conditions and model diameter. These data, together with schlieren studies made at a Mach number of 1.98, show that, for angles-of-attack less than approximately 2°, either of two flow conditions could occur at both Mach numbers. The flow was observed to alternate in a random manner from steady flow to unsteady flow. The heat-transfer coefficients measured for the unsteady flow were approximately 6 to 7 times the coefficients for the steady flow. The ratio of the coefficients for the steady flow to the theoretical values at the stagnation point of a convex hemisphere varied from 0.2 to 0.5. At angles-of-attack of about 2° or more, the heat-transfer rates were at the low level. Author

N63-16332 Aeronautical Systems Div. Propulsion Lab., Wright-Patterson AFB, Ohio
ELECTROFLUIDMECHANICS: INVESTIGATION OF THE EFFECTS OF ELECTROSTATIC FIELDS ON HEAT TRANSFER AND BOUNDARY LAYERS [Final Report]
Henry Rene Velkoff (Ph. D. Thesis–Ohio State U.) Sept. 1962 142 p 31 refs
(ASD-TDR-62-650)

A series of experiments were conducted on the influence of an electric field on free-convection heat transfer. A heated plate was mounted in a Mach-Zehnder interferometer, and the effects of applied electrical fields were studied. Large changes in effective heat transfer were found. Analytical studies were made of this phenomenon. A suitable mathematical model was formulated on the basis of the Von Kármán integral equations and the electrostatic field equations. Correlation between the interferometer test data and the mathematical model was achieved. Exploratory tests of fluid orientation and motion under the influence of dielectric forces were also conducted, and the potential usefulness of the phenomenon is graphically portrayed in pictures showing the motion of water droplets in a "Zero-G" model when a field is applied. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.
For related information see: 16 Life Sciences.

N63-15776 National Aeronautics and Space Administration, Washington, D.C.

EVALUATION OF A TECHNIQUE FOR DETERMINING TIME-INVARIANT AND TIME-VARIANT DYNAMIC CHARACTERISTICS OF HUMAN PILOTS

Jerome I. Elkind, Edward A. Starr, David M. Green and D. Lucille Darley (Bolt, Beranek and Newman, Inc.) May 1963 86 p 38 refs (NASA Contract NASw-185)
(NASA-TN-D-1897) OTS: $2.25

A technique for determining the time-varying dynamic response characteristics of human pilots in tracking tasks is presented. The technique is based on a model adjustment or mimicking procedure in which a model composed of filters whose impulse responses are orthogonalized exponential functions is used. The filters are connected in parallel and their outputs are weighted and added together. The weights are determined so that the mean-square difference between the output of the model and the output of the pilot is minimum. Time-varying characteristics are measured by determining successively the model weights from short samples of the input and output signals of the human operator. The measurement technique has been implemented on a high-speed digital computer. Results obtained by applying the technique to measurement of a variety of digital filters, analog filters, and human-operator dynamic response characteristics are presented. It is shown that a model composed of five properly chosen filters can approximate a large variety of systems with an error of about one percent or less. Author

N63-15793 Martin-Marietta Corp. Space Systems Div., Baltimore, Md.

TOLERANCE AND PERFORMANCE UNDER SEVERE TRANSVERSE ($\pm G_x$)

Denis Faubert, Bruce Cooper, and C. C. Clark Feb. 1963 67 p 22 refs
(ER-12838)

An experiment was carried out in order to study some of the effects that different oscillations and accelerations might have on man's performance and levels of tolerance, particularly when he is experiencing vibrations in a supine position on a contour couch that is restrained by a chest strap, lap belt, and shoulder straps. One hundred and fifteen vibration exposures were applied to seven subjects. Medical monitoring was based on the electrocardiogram and the subjects' comments on discomfort. Although the actual limits of human physiological tolerance were not established, some insight was gained as to the probable implication of internal stresses produced by vibration forces. The most undesirable sensations occurred at 11 cps frequencies. The greatest discomfort for short duration exposures was at 1 $\pm 3G_x$ at 11 cps. Heartbeat rate increase was shown to be independent upon acceleration and frequency, with the greatest increase at 1 $\pm 3G_x$ at 11 cps. J.A.J.

N63-15902 Rocketdyne, Canoga Park, Calif.

MISSILE SYSTEM SAFETY: AN EVALUATION OF SYSTEM TEST DATA (ATLAS MA-3 ENGINE SYSTEM) Human Factors Personnel Subsystems Report

G. A. Peters and F. S. Fall Mar. 1, 1963 298 p refs
(Contract AF 04(694)-8)
(R-5135; ROM-3181-1001)

Human factor data pertaining to the Atlas missile system safety were accumulated during the course of various operational system test exercises. These data were in the form of incidents (deviations/difficulties), which were gathered during the direct observation of various job operations. The purpose of this report is to provide additional pertinent information which was obtained as a result of further updating and detailed analyses of this data. The report is orientated toward the following five objectives: (1) an overall analysis and evaluation of basic data; (2) the prevention of recurrence of problems; (3) information for planning a system safety engineering program; (4) the provision of materials suitable for use in reliability or safety training courses; and (5) the provision of general approaches to system safety engineering and techniques for implementing such an effort. I.v.L.

N63-15947 Northwestern U., Evanston, Ill.

A TEST FOR SPEECH DISCRIMINATION COMPOSED OF CNC MONOSYLLABIC WORDS (N. U. AUDITORY TEST NO. 4)

Tom W. Tillman, Raymond Carhart, and Laura Wilber Brooks AFB, Tex., School of Aerospace Medicine, Jan. 1963 26 p 20 refs (Contract AF 41(657)-418)
(SAM-TDR-62-135)

The N. U. Auditory Test No. 4 is composed of two lists of 50 CNC monosyllabic words each that conform to the phonemic balance advocated by Lehiste and Peterson. The lists were given twice to three different groups of 16 subjects—those with normal hearing, those with conductive losses, and those with sensorineural losses. During each test, six presentation levels of ascending intensities were used, the total range being from −4 db to +40 db sensation level. The three types of subjects evidenced articulation functions of the same shape, but the functions for sensorineurals were of gentler slope than for the other two groups. The discrimination scores for list I were slightly higher than for list II. During the retest, the discrimination scores improved slightly. Scores between lists as well as those from test to retest showed relatively high positive correlation. Therefore, the N. U. Auditory Test No. 4 seems to be a valuable tool for the measurement of phonemic discrimination. Author

N63-15966 Aerospace Medical Div. Aerospace Medical Research Labs. (6750th), Wright-Patterson AFB, Ohio

A BIBLIOGRAPHY OF REPORTS ISSUED BY THE BEHAVIORAL SCIENCES LABORATORY: ENGINEERING PSYCHOLOGY, TRAINING PSYCHOLOGY, ENVIRONMENTAL STRESS, SIMULATION TECHNIQUES, AND PHYSICAL ANTHROPOLOGY, 1946-1962

L. Jean Thomas, comp. Mar. 1963 115 p 907 refs

N63-16012 Northrop Corp. Norair Div., Hawthorne, Calif.

THE INFLUENCE OF MAN ON THE DESIGN OF SPACECRAFT

Robert G. Lindberg, Charles F. Lombard, and Ludwig Roth *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 28, 1962 p 775–789 (See N63-15976 13-01)

The requirements that human tolerances and capabilities place upon spacecraft design are discussed. The response of the human body to physical forces, noise and vibration, inactivity, and environment changes is reviewed. The role of man in man-machine systems is seen as a contribution to the overall flexibility of the system, especially in unpredicted situations, but the value of man will depend upon his ability to function efficiently and reliably throughout the mission. This ability has not yet been demonstrated, nor has the effect of the absence of terrestrial environmental stimuli such as gravity, light, and magnetism. A distinction is made between the degree of stress which a man can tolerate and the degree of stress under which a man can continue to perform analytically. Biologic variability is discussed in relation to the selection of astronauts. Man's nutritional requirements and his need for radiation shielding are considered. The types of environmental control systems engineered to simulate terrestrial environments are reviewed; the advantages and disadvantages of the open cycle, the semiclosed cycle, and the closed cycle systems are presented. Since the level of knowledge in life sciences is still low compared to the material sciences, a much greater effort will have to be expended before really efficient spacecraft can be designed for manned space exploration. M.P.G.

N63-16123 Aerospace Medical Div. Personnel Research Lab. (6570th), Lackland AFB, Tex.

JAN: A TECHNIQUE FOR ANALYZING GROUP JUDGEMENT

Raymond E. Christal Feb. 1963 10 p 7 refs Presented at the annual meeting of the Southwestern Psychological Assoc., Fort Worth, Tex., Apr. 6, 1962

(PRL-TDR-63-3)

This paper indicates how a technique which clusters criteria in terms of the homogeneity of their prediction equations can be used to identify and describe the rating policies within a group or board of judges. The technique measures the consistency of ratings obtained from individual judges, and indicates the amount and nature of agreement between judges or groups of judges. A practical method is suggested for helping a board or committee to reach a consensus concerning how relevant factors shall be weighted in future situations so as to carry out its final joint policy. Examples are given to show how the technique can be used to determine the composition of a service-school-selection composite, to determine factor weights for a job-evaluation plan, and to determine how relevant factors should be combined into a job-oriented criterion composite. Author

N63-16157 Systems Technology, Inc., Inglewood, Calif.

A SYSTEMS ANALYSIS OF LONGITUDINAL PILOTED CONTROL IN CARRIER APPROACH Final Report

C. H. Cromwell and I. L. Ashkenas June 1962 97 p 17 refs

(Contract NOw-61-0519-c)

(Tech. Rept.-124-1)

The pilot's longitudinal control of an aircraft making a carrier approach is studied using systems-analysis techniques. The pilot, airframe, and mirror optical-landing aid are considered as elements in a closed-loop system. Mathematical expressions to approximate each element are derived or described. Various possible piloting techniques are examined by appropriately varying the pilot's transfer function, and by closing multiple control loops around the system. The question of whether the pilot should use stick or throttle for altitude control is examined. It is shown that the minimum approach speeds of five out of seven jet aircraft, all limited by the ability to control altitude and arrest rate of sink, can be predicted if it is assumed that the pilot uses throttle for altitude control. Author

N63-16174 Boeing Co., Wichita, Kan.

HUMAN HEARING AND SPEECH DURING WHOLE-BODY VIBRATION. RESEARCH ON LOW FREQUENCY VIBRATION EFFECTS ON HUMAN PERFORMANCES Technical Report No. 3

Robert J. Teare Apr. 1963 54 p 5 refs

(Contract Nonr-2994(00))

(D3-3512-3)

Binaural thresholds for four tones (500, 1000, 2000, and 4000 cycles per second) and tape recordings of spoken messages were obtained from eight subjects under various conditions of vertical sinusoidal vibration. The vibration frequencies ranged from 1 to 27 cps, and were presented at four subjective reaction levels. These data were systematically compared to control data obtained when no vibration was present. Hearing thresholds were significantly affected by vibration, but the effects were variable from subject to subject and from tone to tone. With one exception, all mean threshold changes fell well within the range of what could be attributed to error of measurement of audiometric thresholds. Since the largest threshold change for any subject under any condition was 7.5 db, the differences were not considered to be of any practical significance within the operational environment. Rated judgments of change in intelligibility and speech "pattern" were inconclusive because of a lack of spread in the ratings. It was noted by the judges that speech became clipped and appeared in short bursts under certain of the vibration conditions. This was particularly true in those frequency ranges where organ displacement had been anticipated. Author

N63-16216 Fundacão Santos Dumont, Sao Paulo (Brazil)

VALUE OF PROFESSIONAL GUIDANCE IN THE TRAINING OF FLIGHT PERSONNEL

José Gonzaga Ferreira de Carvalho *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 31-34 (See N63-16209 13-16)

Psychotechnology covers all phases and modalities of human activity and ergological psychotechnology strives to find the most appropriate job for the best suited individual, thus establishing a basis for his professional training. It is concluded that the UBAC (Uniao Brasleria de Aviadores Civis) assumes responsibility for creating a Department of Psychotechnology that has as many departments as necessary for the study of: professional definition of all the various activities that come under aviation, human market conditions for the selection of advertising and divulgation methods to inform people on all subjects related to aviation, and supervision of projects to be performed by the different sectors of the UBAC. N.E.A.

N63-16217 Fundacão Santos Dumont, São Paulo (Brazil)

DETERMINATION OF THE BLOOD UREA COUNT DURING PERIODIC PHYSICAL EXAMINATIONS OF FLIGHT PERSONNEL

Clemente Lôlo Filho *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 36-38 (See N63-16209 13-16)

From exhaustive study of result data pertaining to 258 urea counts taken on flight personnel during their checkups at the Polyclinic during the period between 1951 and 1958, it was concluded that the urea count does not register any great increase between the ages of 40 and 60 years. Also, modern aviation has no influence on the value of the blood count. Thus the practice of rendering urea blood counts during physical checkups is impractical. N.E.A.

N63-16226 National Physical Lab., Teddington (Gt. Brit.)

CIVIL DEFENCE RESEARCH COMMITTEE. SUB-COMMITTEE G. PHOTOMETRIC PROPERTIES OF THE ATMOSPHERE. VISIBILITY OF LIGHT PATCHES IN LOW ILLUMINATIONS

A. R. Meetham and G. E. V. Lambert Dec. 24, 1941 21 p 3 refs (Declassified)

The contrast required for an average dark-adapted observer to detect a group of irregularly shaped patches of different brightness against a background of uniform low illumination was studied. The problem was broken down into two areas: (1) the contrast adjustment required for the minimum perceptible brightness increment when a single circular patch is replaced by an elliptical patch of the same area; and (2) the contrast adjustment required when a single circular patch is replaced by a regular, circular group of circular patches of equal size and brightness. Results of the first study suggest that the area, rather than the shape, of the patch controls the visibility. Results of the second study indicate that the probability effect for stimulating more response areas in the eye is not much different for a group of patches than for a single patch if the physiological effect is ignored. The results further indicate that, when the groups of patches are arranged in a small circumcircle, the eye tends to respond to the total area illuminated rather than the individual patches. However, in many cases the groups were not much easier to see than the individual patches. However, in many cases the groups were not much easier to see than the individual patches. A working formula is devised and applied to two practical cases of the visibility of lighted places to an observer in an aircraft at night. M.P.G.

N63-16267 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

EFFECTS OF WEIGHTLESSNESS IN BALLISTIC AND ORBITAL FLIGHT Progress Report

James P. Henry et al Repr. from Aerospace Med., v. 33, Sept. 1962 p 1056–1068 50 refs Presented at the Aerospace Med. Assn. Meeting, Atlantic City, Apr. 12, 1962

Data on weightlessness from work with aircraft and from ballistic and orbital rocket flights is evaluated and described in relation to the results of the Mercury MR-2, 3, 4 and the MA-5, 6, and 7 flights. It is concluded that: (1) a person that is firmly attached to his work place can carry out complex visual-motor coordination tasks proficiently for prolonged periods, (2) orientation is little problem if visual and tactile references are present, (3) respiration, digestion, eating, and micturition appear to be unaffected by exposure to the weightless state for periods of hours to days, and (4) weightlessness does not cause drastic changes in the circulation within the course of a few hours and reentry has been tolerated after several days. D.E.R.

N63-16285 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

A BIBLIOGRAPHY OF THE EFFECTS OF TEMPERATURE ON HUMAN PERFORMANCE [Final Report]

John Wing and Robert M. Touchstone Feb. 1963 24 p 162 refs (AMRL-TDR-63-13) OTS: $0.75

This bibliography lists technical reports and journal articles dealing with human performance under both high and low ambient temperatures. The articles and reports have been grouped into sections covering five major performance areas: (1) Sensory Thresholds and Simple Reaction Time, (2) Attention and Perception, (3) Psychomotor Performance, (4) Heavy or Prolonged Physical Work, and (5) Mental Performance. A sixth section of the bibliography lists references which review portions of the literature. Author

N63-16339 Florida State U., Tallahassee

THE EFFECTS ON TRANSFER OF TIME DELAY AND TASK SIMILARITY: A LITERATURE REVIEW

Joel Greenspoon Wright-Patterson AFB, Ohio, Behavioral Sciences Lab. 26 p 59 refs Mar. 1963
(Contract AF 33(616)-6408)
(AMRL-TDR-63-22) OTS: $0.75

A review of selected literature pertinent to the effects of similarity and delay on transfer is reported. Emphasis is given to the more recent research and that which seems to make a greater contribution to knowledge of these effects—especially studies in which similarity and time delay were manipulated jointly. Effective prediction on the basis of similarity will depend on the development of a rigorous and reliable technique for its measurement. The effects of delay can be adequately determined only after this is accomplished. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-15866 Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio

THE EFFECT OF NUCLEAR RADIATION ON TRANSDUCERS

W. E. Chapin, D. J. Hamman, and E. N. Wyler Apr. 19, 1963 141 p 55 refs
(Contract AF 33(657)-10085)
(REIC-25)

The first section contains information dealing with concepts and characteristics of conventional transducers with estimation of values of radiation thresholds. Information is also included on research and development programs currently in progress or completed. The information presented can serve a useful purpose to designers and electronic-component users as a guide for developing a better understanding of the problems that must be solved prior to final selection of transducers to be used in nuclear environment. Author

N63-15957 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

A STEADY-STATE, STAGNATION-POINT, HEAT-TRANSFER-RATE MEASURING DEVICE

George E. Glawe, Lloyd N. Krause, and Robert C. Johnson Washington, NASA, May 1963 17 p 31 refs
(NASA TN D-1704) OTS: $0.50

A sensing device is described that is used to measure steady-state convective heat-transfer rate in high-temperature, high-velocity gas streams. The device uses the measurement of axial heat conduction through a cylindrical plug, with one end of the plug at the stagnation point of a hemispherically shaped body exposed to the gas stream. Experimental tests of three identical probes run through a subsonic Mach-number range from 0.2 to 0.8, and a supersonic Mach-number range of 2.8 to 3.5 established a correlation factor for the probes with a standard deviation of ± 5 percent. The heat input range was 0.7 to 70 $Btu/ft^{-2}/sec^{-1}$. Author

N63-15959 Land-Air, Inc., Holloman, N. Mex.

AIRBORNE FLASHING LIGHT BEACON

Apr. 1962 14 p 2 refs

The flashing light beacon, designed to be carried aboard a missile or experimental aircraft, provides a high-intensity flare of short duration which makes a well-defined image when photographed by an astrographic ballistic camera during high-altitude missions. The resulting photographic record is of such quality as to provide data from which velocity, acceleration, and trajectory may be calculated by computer techniques. The repetition rate and intensity of the flare are accurately controlled, and may be programed to the requirements of a given mission. It has been determined that approximately 300 joules are necessary to reproduce the minimum photographic dot diameter at altitudes approaching 100 miles. In current tests, 50 watt-seconds have been used at altitudes from 80,000 to 100,000 feet. The relationship between applied voltage and capacitance determine the watt-second input and output. The flash duration and the "blur" effect, also determined by the voltage-capacitance relationship, are directly related to the velocity of the missile. The beacon package used in Nike-Hercules tests is shown as well as the interrelationship of the components. Author

N63-16001 Bell Aerosystems Co. Inertial Development Labs., North Tonawanda, N.Y.

TORQUE MODULATION AND MODULATION ERROR DETECTION CONCEPTS IN MODERN GUIDANCE INSTRUMENTS

H. Schlitt *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 561-572 (See N63-15976 13-01)

The research and development activities carried out by Bell Aerosystems are discussed to show the contributions made in the instrument field. The discussion includes the following: conventional basic instrument concepts, torque modulation concept for

measuring instruments, torque modulation concept for high-performance gyroscopes and accelerometers, and modulation-error-detection concept and techniques. R.C.M.

N63-16008 North American Aviation Inc. Space and Information Systems Div., Downey, Calif.
THE INTERVAL TRANSFORMER TANK LEVEL AND FLOW GAGE
Dieter K. Huzel *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 711-722 (See N63-15976 13-01)

The interval transformer gage (also known as the inductance gage) was the result of a search for improved liquid propellant flow metering methods. The basic system, first proposed in 1951, consisted of a number of fixed coils enclosed in a metallic tube installed vertically in the propellant tank and connected electrically in a Wheatstone bridge arrangement. A toroidal float encircled the tube; as the float passed each coil it altered the magnetic field of that coil thus unbalancing the bridge. The bridge output was recorded on a galvanometer oscillograph, providing a precise time record of the liquid level as it passed each coil. Steady flow rates were determined with great accuracy, and after calibration with the actual ducting and propellant, transient flow rates were also metered. Modifications of this basic gage have been in use for more than a decade, and, although the magnetically triggered switch is gradually replacing the transformer coils of the interval gages, much of the technology developed earlier remains applicable. M.P.G.

N63-16031 Oak Ridge National Lab., Tenn.
HEALTH PHYSICS INSTRUMENT MANUAL
D. M. Davis and E. D. Gupton May 16, 1963 139 p refs
(Contract W-7405-eng-26)
(ORNL-332 (3rd Ed.)) OTS: $2.50

This reference to radiation monitoring instruments gives their most prominent characteristics and uses. Also, radiation sources, and calibration procedures and devices are discussed. The ORNL badge dosimeter for personnel monitoring is described to provide health physics surveyors with a working knowledge of the radiation-detection and -measuring devices, so as to enable them to choose devices for their own use based on availability, stage of development and testing, and cost. D.E.R.

N63-16087 Portsmouth Naval Shipyard, N.H.
AUTOMATED MECHANICAL IMPEDANCE MEASURING INSTRUMENTATION SYSTEM
J. E. Smith *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 134-149 (See N63-16076 13-33)

This paper describes the automated mechanical impedance and phase-angle measuring system developed by, and currently in use at, the Portsmouth Naval Shipyard. The theory of operation of the system is discussed as well as the practical aspects of data reliability and repeatability, and system operating characteristics. Author

N63-16088 Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.
AIRBORNE VIBRATION SPECTRUM ANALYSIS: SOME TECHNIQUES AND LIMITATIONS
D. N. Keast, J. Gibbons, and W. E. Fletcher *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 150-166 12 refs (See N63-16076 13-33)
(Supported by TITAN Prog. Office of Space Technol. Labs., Inc.)

The large telemetry bandwidth required by flight-vibration measurements has led to the use of airborne vibration-spectrum analyzers. Criteria for the selection of these instruments are presented. One airborne spectrum-analysis system currently in use is described in some detail. Other possible systems are also discussed. Author

N63-16089 Detroit Arsenal, Center Line, Mich.
INSTRUMENTATION AND ITS ROLE IN THE DEVELOPMENT OF A NEW VEHICLE
John F. Elsenheimer *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 167-182 (See N63-16076 13-33)

The instrumentation and testing of a vehicle from concept to production are described. Acceleration of the vehicle's center of gravity, drawbar pull, bump stop load, shock absorber load, acceleration of front-end of vehicle, torsion bar angular motion, engine speed, vehicle speed, and mat-type bump are discussed. N.E.A.

N63-16090 Space Technology Labs., Inc., Redondo Beach, Calif.
ACCELEROMETER SENSITIVITY TO DYNAMIC PRESSURE PULSES
John R. Fowler and William S. Tierney *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 183-194 2 refs (See N63-16076 13-33)

It is necessary to know the response to a dynamic pressure input when using accelerometers in pressure fields. In order to evaluate this effect, several different manufacturers' accelerometers were subjected to pressure pulses varying from 20 to 150 psi, approximately. This paper shows the experimental equipment used, presents the data obtained, and compares various accelerometers. Author

N63-16094 Sandia Corp., Albuquerque, N. Mex.
REAL-TIME ANALYSIS OF RANDOM VIBRATION POWER DENSITY SPECTRA
P. T. Schoenemann *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 232-239 3 refs This paper was not presented at Symp. (See N63-16076 13-33)

This paper describes an analysis method which uses a multiple-filter spectrum analyzer operation in real time, that is capable of providing power density spectra, Fourier analysis, and a bandpass filter analysis. The use of a multiple-filter spectrum analyzer allows real-time reduction of random vibration data. Because all of the spectrum is observed for all of the time, the analysis of nonstationary phenomena is also facilitated. N.E.A.

N63-16095 Minneapolis-Honeywell Regulator Co., Minn.
TWO NEW SYSTEMS FOR MEASURING VIBRATION DATA IN THE FREQUENCY DOMAIN
Earl Channell and Robert Clautice *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 240-253 4 refs This paper was not presented at Symp. (See N63-16076 13-33)

Two analysis systems—a 1/3-octave-band true-rms spectral analyzer and a narrow-band heterodyne true-rms spectral analyzer—have been developed. These systems were developed for the aeronautical system division's new sonic test facility. Author

N63-16096 Martin Co., Denver, Colo.

ACOUSTIC AND VIBRATION STANDARD ENVIRONMENTAL DATA ACQUISITION PROCEDURES

Richard W. Peverley *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962 Apr. 1963 p 254-260 5 refs This paper was not presented at Symp. (See N63-16076 13-33)

This paper discusses requirements necessary for obtaining good quality acoustic and vibration data. Included are frequency response, dynamic range, linearity, interchannel phase shift, response to environments, calibration, and accuracy. Only those factors which can be controlled by the person requesting data are discussed. Author

N63-16149 California U., Berkeley. Lawrence Radiation Lab.

ULTRACENTRIFUGE PHOTOELECTRIC SCANNER, SPLIT-BEAM

Kenneth W. Lamers Oct. 9, 1962 68 p 5 refs
(Contract W-7405-eng-48)
(UCRL-10499) OTS: $1.75

This report describes an electromechanical scanner for displaying optical density changes when a light-absorbing material such as virus, protein, or nucleic acid is sedimenting in the centrifugal field of an ultracentrifuge; that is, a high-speed centrifuge employing an optical system. These materials absorb some of the light transmitted by the optical system, thereby projecting an image that varies in intensity with distance from the center of rotation. This image, which consists of alternate light pulses from a reference and a sample cell, is scanned by a photomultiplier. Subsequent circuitry separates the reference and sample pulses and takes their logarithmic difference. The system, therefore, compensates for nonuniform illumination and other optical imperfections. The logarithmic difference is displayed on a chart recorder, the paper moving in synchronism with the scanner. Optical density (concentration) is thereby displayed as a function of radius. An additional trace simultaneously records the derivative of the density profile. Other modes record the image of each cell before optical correction. An internal calibration feature permits absolute measurement of optical density. Author

N63-16182 Union Carbide Research Inst., Tarrytown, N.Y.

A SENSITIVE AC POTENTIOMETER FOR GALVANOMAGNETIC MEASUREMENTS

John Piper Apr. 1963 23 p 12 refs
(Contract DA-30-069-ORD-2787)
(Tech. Rept. C-15)

The construction and operation of a sensitive a.c. potentiometer is described. It is specifically suited for the measurement of low-level voltages caused by the application of a primary current to a system under examination, and has been applied to the measurement of galvanomagnetic effects, superconductivity, and magnetic susceptibility. Author

N63-16269 Hoffman Electronics Corp. Hoffman Semiconductor Div., El Monte, Calif.

SOLAR ENERGY MEASUREMENT TECHNIQUES [Final Report, Mar. 1961-Aug. 31, 1962]

Bernd Ross and D. B. Bickler Wright-Patterson AFB, Ohio, Flight Accessories Lab., Jan. 1963 165 p 56 refs
(Contract AF 33(616)-7946)
(ASD-TDR-62-882)

This report describes a broad investigation which has been made of the subject of solar-cell measurements. A portable tester has been designed and built which will enable an operator to determine the output of a solar-cell power supply in space by analyzing output under conditions existing at either laboratory or field test sites. Author

N63-16340 Thomas (A. S.) Inc., Westwood, Mass.

NEW TECHNIQUES OF PATTERN SHAPING FOR LOW SILHOUETTE ANTENNAS Final Report

Abdelnour S. Thomas Jan. 1963 111 p 6 refs
(Contract AF 19(604)-4983)
(M58-4; AFCRL-63-102)

The infinite modulated reactance sheet is studied with the phase and amplitude contours of the near field presented. It is shown that the infinite reactance sheet is an excellent description of the modulated Yagi. Experimental radiation patterns of low sidelobe endfire arrays are given, together with radiation patterns of Yagi arrays giving cosecant-type radiations, flat-top flared beams, and beams at an arbitrary angle. The beams at an arbitrary angle are obtained from a cosine to the even power modulation of the relative wave number. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-15764 Naval Radiological Defense Lab., San Francisco, Calif.

THE EFFECT OF AGE AT EXPOSURE UPON THE RADIATION INDUCED DENTAL DEFECT IN RATS

D. C. Jones, T. J. Castanera, and D. J. Kimeldorf Mar. 21, 1963 17 p 8 refs
(USNRDL-TR-634)

Exposure of the rat to ionizing radiation results in formation of defective tooth substance, which subsequently becomes visible at the gingival crest in the shaft of the continuously growing incisor. The present study is concerned with the effect of age at irradiation upon the severity and temporal distribution of the radiation-induced dental lesion. Male rats were irradiated with a high sublethal dose (215 rads) of fast neutrons at 31, 110, or 619 days of age. The typical lesion (a chalky zone extending the full width of the tooth) was observed in the exposed shafts of the incisors, beginning in the second month post-irradiation. While all animals exhibited the lesion in all incisors, the character of the lesion and its time sequence varied markedly with age at irradiation. The severity of the radiation effect was greater in the youngest group, as indicated by a wider lesion and a greater incidence of animals with fractured incisors (68% vs. 11% or 12% for the older groups). The time sequence of appearance, duration of visibility, and disappearance by attrition at the occlusal edge occurred earlier in younger animals. However, these temporal differences appear related primarily to anatomic and physiologic factors associated with age rather than to a differential intensity of radiation damage. Author

N63-15799 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ELECTRICAL ENERGY FROM BIOLOGICAL SYSTEMS

J. J. Konikoff, L. W. Reynolds, and E. S. Harris Apr. 1963 22 p 7 refs Presented at the 34th Annual Scientific Meeting of the Aerospace Med. Assn., Los Angeles, Apr. 29-May 2, 1963 Submitted for Publication
(NASA Contract NASw-511)
OTS: $2.60 ph, $0.86 mf

A biological fuel cell which will yield small but useful quantities of direct current as the result of the metabolic activity of certain microorganisms has been produced. The possibility of a biochemical reaction to solving the problem of waste management in a closed ecological system is discussed. J.A.J.

N63-15846 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

CURRENT CONCEPTS OF ACUTE CARBON TETRACHLORIDE HEPATOTOXICITY

Philip W. Andrews Feb. 1963 29 p 181 refs

(*Its* Aeromedical Review 2-63)

A literature survey of hydrocarbon-induced, experimental, acute hepatotoxicity was made. It was concluded that CCl_4, and probably other hydrocarbons, directly interfere with the selective permeability of the liver cell wall and membranous endoplasmic reticulum for electrolytes, water, and certain hydrophilic proteins. Concomitantly, the toxin stimulates the sympathetic nervous system and the release of its hormones. These reduce hepatic blood flow, by vasoconstriction, thereby inducing centrilobular hypoxia, degeneration, and necrosis. These also cause massive mobilization of fats from the peripheral depots. These fats accumulate in the liver where their secretion, as triglycerides, is blocked by unknown mechanisms. Author

N63-15847 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

CATECHOLAMINE EXCRETION IN HEAT-ACCLIMATIZED MEN

Henry B. Hale, Edgar W. Williams, and James P. Ellis, Jr. Mar. 1963 9 p 17 refs

(SAM-TDR-63-20)

Sympathoadrenal activity was appraised in 10 healthy men over a 10-week period, beginning in summer and ending in autumn. Two overnight urine samples per subject per week were analyzed for norepinephrine, epinephrine, creatinine, and urea. Evidence of high sympathoadrenal activity was obtained in summer, with reversal in autumn. The different catecholamines were shown to relate either to weekly mean maximum temperature, to weekly mean solar radiation, or to both climatic factors. Catecholamine excretion also tended to vary inversely with urea excretion, which may be interpreted as indicating interaction between catecholamines and thyroid hormone, the latter possibly modifying metabolic actions of the former. The results also may be interpreted as indicating that catecholamines contribute to the regulation of blood distribution, a function of major importance in heat acclimatization. Author

N63-15849 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)

ELECTRONIC DELOCALIZATION AND BIOCHEMICAL EVOLUTION

Bernard Pullman and Alberte Pullman (Paris U.) Nov. 15, 1962 17 p 50 refs Presented at the Symp. of the 4th Intern. Summer Inst. in Quantum Chem. and Solid State Phys., Rättvik, Dalerna, Sweden, Aug. 27–Sept. 1, 1962

(Sponsored by the Swed. Nat. Sci. Res. Council and U.S. Air Force) (Preprint 86)

The characteristics of biochemical molecules are discussed, in an attempt to find the basic factors which make such molecules the building blocks of living organisms. It is found that most, if not all, of the proteinaceous compounds that make up the principal part of living cells are highly conjugated compounds, and that these are involved in electron transfer phenomena, which are intimately linked with the basic manifestations of life. Electron delocalization is the most important characteristic of such compounds in terms of the stability and functional advantages required of biological cells. It is postulated that their resonance energy gives them stability and their semiconductive properties give them functional advantages. Biochemical evolution and the role of resonating structures in evolution is also discussed. D.E.R.

N63-15885 Pasadena Foundation for Medical Research, Calif.

RADIOPROTECTIVE AGENTS: A CORRELATIVE STUDY OF RNA CONTENT AND THE DEGREE OF RADIORESISTANCE OF CELLS IN VITRO

Donald E. Rounds and William C. Slick Brooks AFB, Tex., School of Aerospace Med., Mar. 1963 8 p 7 refs

(Contract AF 41(657)-337)

(SAM-TDR-63-17)

In vitro studies revealed that a 24-hour preirradiation treatment of an amnion cell line with yeast RNA increased cell survival in proportion to the yeast RNA content in the medium. Conversely, ribonuclease treatment increased radiosensitivity. However, the protective response was observed only after 8 to 10 hours of preirradiation treatment with yeast RNA. Some increase in cell survival was recorded at 4 to 6 hours when an alkaline hydrolysate of yeast RNA was used. Microspectrophotometric measurements of cytoplasmic basophilia revealed substantially increased optical density within 4 hours of incubation with RNA. The delay in a protective response during this period may have been due to the time required for digestion and resynthesis into an active radioprotective agent. A correlation between RNA synthesis and the radioprotective response confirmed this hypothesis. Author

N63-15888 Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge

NEUROLOGICAL MODELS AND INTEGRATIVE PROCESSES

Warren S. Mc Culloch, Michael A. Arbib, and Jack D. Cowan [1962] 11 p 13 refs

(Contract AF 33(616)-7783; NIH Grant B-1865-(C3))

Neurological work for the last four years is summarized. The basis for research is given as the attempt to construct models of the operation of the nervous system. The models chiefly concern the functional organization of the nervous system that considers the anatomy as it structurally limits the circuit actions and defines the sites of excitation and activity. The work was based on an electrical hypothesis of central inhibition and excitation. D.E.R.

N63-15903 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

A DIGITAL READOUT TECHNIC APPLICABLE TO LABORATORY AND AEROSPACE MEDICAL MONITORING OF PHYSIOLOGIC DATA

Odo Siahaya, Alan R. Kahn and Ray W. Ware Feb. 1963 18 p 4 refs

(SAM-TDR-62-139)

This report describes a technique for digital readout of systolic and diastolic blood pressure, heart rate, and respiratory minute volume, applicable to wire telemetry in the laboratory as well as wireless telemetry from aerospace vehicles. General description of the technique and specific construction details are given. Author

N63-15925 General American Transportation Corp. Mechanics Research Div., Niles, Ill.

CARBON DIOXIDE REDUCTION SYSTEM [Final Report, Apr. 1961–Aug. 1962]

G. A. Remus, R. B. Neveril, and J. D. Zeff Wright-Patterson AFB, Ohio, Life Support Systems Lab., Jan. 1963 82 p 4 refs

(Contract AF 33(616)-8223)

(GATC-MR-1163-50; AMRL-TDR-63-7) OTS: $2.25

An automatically operated carbon dioxide reduction system was designed, fabricated, and tested. The system will reduce 0.365 pounds of carbon dioxide per hour, equivalent to a 3.2-man carbon-dioxide output, and is required for providing respiratory support for man on extended space missions. The program was conducted in three phases: analysis of a reactor developed on a previous contract, experimental determination of design parameters, and fabrication and testing of an improved engineering model. Operating characteristics, feed gas compositions, recycle flow rates, reaction temperatures and pressures, and catalyst composition and configuration were established, and the effects of variations in these were determined. Author

N63-16013 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL BIOLOGY IN SPACE

Richard S. Young *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 791-802 (See N63-15976 13-01)

The possibilities of space as a fundamental biologic research tool are discussed. Among the possibilities are an understanding of the origin of life on earth and elsewhere, studies of parameters such as zero-gravity and cosmic radiation which cannot be duplicated in the laboratory, and studies of the long- and short-term effects of the absence of any or all of the multiple factors (gravity, magnetic fields, radiations) comprising the total physical environment in which life on earth has evolved. Unfortunately, most of the space biology experiments have been unsuccessful due to improper vehicle performance, but much has been learned about packaging of experiments, experimental controls, launch and recovery operations, and experimental design and interpretation. The experience thus obtained is used to define the requirements which must be met if biological investigations in space are to be fruitful. M.P.G.

N63-16035 California U., Berkeley. Lawrence Radiation Lab.

NEUTRON TISSUE DOSE AT LARGE DISTANCES FROM AN ELEVATED UNSHIELDED REACTOR

Henry Aceto, Jr., Michael A. Pick, and Lloyd D. Stephens Mar. 11, 1963 19 p 10 refs

(Contract W-7405-eng-48)

(UCRL-10559)

The neutron tissue dose at large distances from a fission source was studied by using a water-filled phantom and four different detectors: a BF_3 counter, a polyethylene-lined, ethylene-filled proportional counter, indium foils, and nuclear emulsions. The source of fission neutrons was the ORNL Health Physics Research Reactor which was attached to a hoist which was, in turn, installed on a 1530-foot tower. The reactor could be operated at any elevation from 27 to 1500 ft. The phantom studies were made at horizontal distances from 250 to 1500 yards from the tower. Dose contributions from recoil protons, H^1 (n, γ)D^2 and N^{14} (n, p)C^{14} reactions are considered. Author

N63-16040 Atomic Energy Commission, Bombay (India)

ESTIMATES OF BIOSPHERIC CONTAMINATION AND RADIATION DOSE FROM NUCLEAR EXPLOSIONS UP TO APRIL 1962

K. G. Vohra, C. Rangarajan and Kumari G. Sarada 1962 30 p 15 refs

(AEET/AM/27)

The production and dispersion of fission products and induced radioactivity from nuclear-weapon tests are discussed. Estimates are given of the important radionuclides released by the tests conducted up to November 1961. The internal and external doses from fission products are calculated on the basis of mean residence times in the stratosphere. The gamma dose calculated from the actual measurements of surface fallout activity at two stations in India, viz., Srinagar and Bombay, are also presented. The estimated contributions of the various test series to the gamma dose at the two stations are discussed. Author

N63-16043 Wisconsin U., Madison

A STOCHASTIC MODEL FOR THE INTERPRETATION OF CLINICAL TRIALS Technical Summary Report

George H. Weiss (Maryland U.) and Marvin Zelen Mar. 1963 16 p 6 refs

(Contract DA-11-022-ORD-2059; NONR-595(17))

(MRC-385)

There are several diseases which can be characterized by the patient being in one of a finite number of states; e.g., relapse, remissive, toxic, etc. These states may be both transient and absorbing. Other authors have proposed similar models to describe data dealing with time-dependent phenomena which have assumed that the distribution spent within any state is exponential. These models are all Markovian. In this paper we develop non-Markovian models which allow arbitrary distributions within a state. The model is applied to clinical trials of patients with acute leukemia who are undergoing experimental therapy. The agreement of the model and the data is very good. Author

N63-16122 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

ASTRONAUTICS INFORMATION. EFFECTS OF STERILIZING AGENTS ON MICROORGANISMS

Janet Swift, comp. Mar. 1963 74 p 420 refs

(NASA Contract NAS7-100)

(JPLAI/LS-260, Suppl.) OTS: $7.60 ph, $2.42 mf

This supplementary compilation of abstracts on sterilization of microorganisms places special emphasis on chemical sterilizing agents. The chemical agents of particular interest are ethylene oxide, β-propiolactone, propylene oxide, and ozone. B.J.C.

N63-16126 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

THE SENSITIVITY TO STIMULATION OF THE SEMICIRCULAR CANALS DURING WEIGHTLESSNESS Joint Report

Ashton Graybiel (Naval School of Aviation Med.), James A. Roman, Bruce H. Warren Feb. 1963 16 p 5 refs

(SAM-TDR-62-148)

The sensitivity to stimulation of the semicircular canals during periods of weightlessness averaging 46 seconds was estimated by timing the duration of apparent rotation of a visual target and of the subject's perception of rotation after stimulation. Stimulation was accomplished by rolling the aircraft during periods of subgravity as well as during 1-g control maneuvers. Time-intensity relationships of the stimulus were obtained by means of specialized instrumentation incorporated into the experimental subject's crash helmet. Author

N63-16127 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.

STUDIES IN DECOMPRESSION SICKNESS: CIRCULATORY AND RESPIRATORY CHANGES ASSOCIATED WITH DECOMPRESSION SICKNESS IN ANESTHETIZED DOGS

Sidney D. Leverett, Jr., Harold L. Bitter, and Robert G. Mc Iver Mar. 1963 16 p 15 refs

(SAM-TDR-63-7)

Twenty-four dogs were utilized in evaluating physiologic effects of intravascular bubbles. High and low atmospheric pressures were used, as well as direct introduction of air bubbles into the circulation. In all cases, the signs appearing as the result of intravascular bubbles were (1) marked tachypnea and (2) marked pulmonary arterial hypertension. Bubbles appeared first in the venous circulation, and were not seen in the arterial circulation until near collapse. Bubbles produced at altitude did not completely disappear on returning to ground level. Author

N63-16152 Connecticut Agricultural Experiment Station, New Haven

OPTIMUM LIGHTING OF LEAVES

Dale N. Moss [1963] 25 p 5 refs Submitted for Publication

(NASA Contract NASr-129)

OTS: $2.60 ph, $0.95 mf

Photosynthesis of upper and lower leaf surfaces under varying intensities of light (0 to 1,000 ft. c) was studied in two monocotyledonous plants—maize (*Zea mays*) and sugar cane (*Saccharum officinarum*); and in two dicotyledonous plants—sunflower (*Helianthus annuus*) and tobacco (*Nicotiana tabacum*). The monocotyledons responded to light on both the upper and the lower surfaces equally; the dicotyledons responded less well to light directed on

the lower surface presumably because of leaf structure. Illumination from beneath desiccated the dicotyledon stomata as well. Humidity increased the aperture of the stomata on the lower leaf surface allowing an increase in photosynthesis. The light maximum in photosynthesis was the same for both leaf surfaces. Lighting both sides of the leaves of all four species with dim light caused a marked increase in photosynthesis compared with the same lighting on one surface only. A.F.

N63-16209 Fundacão Santos Dumont, São Paulo (Brazil)

FOURTH BRAZILIAN CONGRESS ON AERONAUTICS

Dec. 1961 52 p 5 refs Transl. by Michel Valeur from the Annals on Aviation Medicine

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N63-16210 Fundacão Santos Dumont, São Paulo (Brazil)

SINUSBAROPATHY

Adelmo Mello Souza Leão (Aeronautic Polyclinic of São Paulo) *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 1–3 5 refs (See N63-16209 13-16)

It is proposed that the term "aerosinuitis" be replaced by the term "sinusbaropathy" to better depict the range of morbid alterations which occur within the paranasal cavities as a result of barometric variations during flight. This denomination is more precise for guiding the etiopathology and the nature of this ailment. A classification of "sinusbaropathies" that indicates their diagnosis and treatment is given. N.E.A.

N63-16211 Fundacão Santos Dumont, São Paulo (Brazil)

IMPORTANCE OF ABREUGRAPHIC CONTROL IN ROUTINE MEDICAL EXAMINATIONS OF FLIGHT PERSONNEL

Walter Cardoso Rossi (Aeronautic Polyclinic of São Paulo) *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 4–6 (See N63-16209 13-16)

Use of the Abreugraphy (chest X-ray) process is stressed. This process, because of its practical value, allows the early diagnosis of numerous pulmonary and cardiovascular lesions and also constitutes an undoubtedly important element for the precise guidance of those in charge of occupational decisions. Out of 1500 cases investigated at the Aeronautic Polyclinic in which persons were considered clinically healthy, there were 47 defective X-rays with 4 tubercular lesions, 12 with probable cardiocircular lesions, and the others with scar lesions and predisposition toward thoracic illnesses. N.E.A.

N63-16212 Fundacão Santos Dumont, São Paulo (Brazil)

X-RAY OF THE PARANASAL MEMBRANES FOR THE SELECTION AND HEALTH CONTROL OF FLIGHT PERSONNEL

Adelmo Mello Souza Leão and Walter Cardoso Rossi (Aeronautic Polyclinic of São Paulo) *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 7–9 (See N63-16209 13-16)

Flight personnel is frequently subject to more or less intense ailments of the paranasal cavities through the action of barometric variations in flight. An X-ray examination of the paranasal cavities allows an early diagnosis of sinusbaropathy. It is recommended that routine physical checkups should include X-ray examinations, especially when the purpose of the examination is for the selection of flight personnel for the aeronautic organization. N.E.A.

N63-16213 Fundacão Santos Dumont, São Paulo (Brazil)

COMPULSORY PERIODIC MEDICAL EXAMINATION OF FLIGHT ATTENDANTS

José Gonzaga Ferreira de Carvalho *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 14–17 (See N63-16209 13-16)

It is suggested that compulsory medical examinations for all flight attendants, both male and female, be re-established. Also, it is proposed that: all flight attendants, while on duty, submit annually to a health inspection to check their current state of physical and mental health; the Air Ministry Teams be deemed competent to perform the examinations; and the Health Team makes a health check of all personnel that are separated from their duties for a period of time in excess of 60 days, if they are to resume their duties with the same or another company. N.E.A.

N63-16214 Fundacão Santos Dumont, São Paulo (Brazil)

OPERATIONAL FATIGUE: CONCEPT, ETIOPATHOLOGY AND PREVENTION

José Gonzaga Ferreira de Carvalho *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 18–22 (See N63-16209 13-16)

Operational fatigue is defined as a complex syndrome that affects flight personnel and is characterized by psychic and organic disturbances which occur along with a decrease of operational capacity and a more or less intense alteration of the aviator's behavior attitude. The etiology of this syndrome can be represented by factors pertaining to the flyer himself, the aircraft, and the conditions of the flight. For the prevention of operational fatigue within an organization, the joint and effective participation of the medical department, maintenance department, and chief of operations becomes necessary. It is suggested that a permanent commission for the prevention of operational fatigue be established and maintained in each organization, and that it be made up of the heads of the mentioned departments, so that they may analyze, establish, and enforce all measures adopted for the prevention of operational fatigue. N.E.A.

N63-16215 Fundacão Santos Dumont, São Paulo (Brazil)

CARRIAGEABILITY BY AIR OF CHILDREN, PREGNANT WOMEN AND SICK PERSONS

Vitor Pereira and Miguel Zupo ("REAL" Airlines) *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 23-30 (See N63-16209 13-16)

The carriage-ability by air of sick persons is discussed. Also, the unfavorable conditions that an individual may encounter in flight are covered: anoxia, low atmospheric pressure (height sickness), flight tension, and air sickness. N.E.A.

N63-16218 Fundacão Santos Dumont, São Paulo (Brazil)

DIET PROBLEMS OF FLIGHT PERSONNEL

Eduardo Cordeiro Filho *In its* Fourth Brazilian Congress on Aeronautics Dec. 1961 p 39–48 (See N63-16209 13-16)

Diet factors for flight personnel, when performing their duties, are described. Current difficulties which have been observed in the Brazilian Aviation Groups are discussed so that the dietetic demands of flight personnel may be met. N.E.A.

N63-16286 Indiana U. Foundation. Hearing and Communication Lab., Bloomington

CUMULATIVE AUDITORY EFFECTS RESULTING FROM MULTIPLE EXPOSURE TO INTENSE ACOUSTIC STIMULATION. PART I. DEAFENING EFFECTS OF NOISE ON THE CAT [Final Report]

James D. Miller and Charles S. Watson Wright-Patterson AFB, Ohio, Biomedical Lab., Dec. 1962 84 p 41 refs
(Contract AF 33(616)-3844)
(AMRL-TDR-62-99(I)) OTS: $2.25

Aural effects of exposure to intense noise were investigated by measurements of the auditory sensitivity of cats, as determined by their behavior, before and after exposures and by histological examination of their cochleas. Exposures to 115 db for 1 8 hour or 105 db for 1/4 hour result in temporary threshold shift (TTS) with the same general features and course of recovery as for man. However, 1/4-hour exposures require 18 db less sound to produce the same magnitude of shift in the cat. Noise of 115 db for 1/4, 1/2, 2, or 8 hours without interruption produced permanent threshold shift (PTS) in which magnitude depended on the duration of the exposure, the test-tone frequency, and the susceptibility of the individual cat. When the 2-hour exposure was divided into 16 doses of 1/8 hour each and four different interexposure intervals of 0, 1, 6, and 24 hours were used, PTS declined as interexposure interval increased. Author

N63-16287 Sandia Corp., Albuquerque, N. Mex.

CONFERENCE ON CLEAN ROOM SPECIFICATIONS, HELD AT SANDIA LABORATORY, ALBUQUERQUE, NEW MEXICO, APRIL 9-10, 1963

B. A. Bice et al May 1963 103 p
(Supported by AEC)
(SCR-652) OTS: $2.50

Objectives were to develop a Federal Performance Standard for the construction, operation, and monitoring of clean room facilities. The followng subjects were covered: need for a uniform specification; general aspects of contamination control; cleanliness versus need; contamination—cleaning and verification; Air Force revised Technical Order 00-25-203 relating to clean rooms; Navy specifications and facilities; U.S. Army MIL*STD*1246(MI); state of the art (contamination control) and laminar airflow concept; laminar air cross-flow room; clean bench; adaptability of laminar airflow for contamination control; and a special Sandia-prepared for a straw-man standard proposal for clean rooms. N.E.A.

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-15769 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

INFLUENCE OF MICROSTRUCTURAL INCLUSIONS ON FRICTION AND WEAR OF NICKEL AND IRON IN VACUUM TO 10^{-9} MILLIMETER OF MERCURY

Donald H. Buckley and Robert L. Johnson Washington, NASA, May 1963 25 p 14 refs
(NASA TN D-1708) OTS: $0.75

Friction, wear, and welding characteristics of three binary alloy systems were studied at ambient pressures from 760 to 10^{-9} millimeter of mercury. Studies were conducted with nickel-oxygen, nickel-tin, and iron-sulfur alloys. Friction and wear studies were made with a hemispherical (3/16-in. rad.) rider, which slides in a circumferential path on the flat surface of a rotating metal disk of the same material. The specimens were tested at various ambient pressures with a load of 1000 grams (2.2 lb), a sliding velocity of 28 to 1800 feet per minute, and a temperature of 75° F. The incorporation of nickel oxide (1.35 to 7.50 percent) in electrolytic nickel resulted in friction and wear properties in vacuum for nickel, which were characteristic of that experienced for nickel-base alloys in air at atmospheric pressure. The addition of tin (optimum 20-percent tin) to electrolytic nickel reduced friction and wear of nickel in vacuum by a factor of 10. The fundamental lubrication mechanism, however, is not the same for the two alloy systems. The addition of various percentages of sulfur (present as ferrous sulfide) to electrolytic iron (0.01- to 0.45-percent sulfur) reduced friction, wear, and welding of electrolytic iron in vacuum (10^{-9} mm Hg). Author

N63-15785 Mechanical Technology, Inc., Latham, N.Y.

STABILITY ANALYSIS OF GAS LUBRICATED SELF-ACTING PLAIN CYLINDRICAL BEARINGS OF FINITE LENGTH, USING GALERKIN'S METHOD Technical Report

H. S. Cheng and C. H. T. Pan Apr. 19, 1963 62 p 17 refs
(Contract Nonr 3730(00)FBM))
(MTI-63TR15)

The present paper extends the method of Cheng and Trumpler to study stability of plain, cylindrical, gas journal bearings of finite length. Both equilibrium and stability results have been obtained. Author

N63-15797 Franklin Inst., Philadelphia, Pa.

INVESTIGATION OF THE STRUCTURAL AND MAGNETIC PROPERTIES OF THIN FERROMAGNETIC FILMS [Final Report, May 1, 1959–July 31, 1962]

A. Baltz and William Doyle Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 73 p 68 refs
(Contracts AF 33(657)-8940 and AF 33(616)-6298)
(WADD-TR-60-787, Pt. II)

Permalloy films evaporated at normal and oblique incidence to a substrate were examined by replication of their surfaces. Electron micrographs revealed chains of particles perpendicular to the incident beam when the angle of incidence was $<70°$ and parallel to the incident beam when the angle was $<70°$. The degree of alignment depended upon the angle-of-incidence and thickness of the film. A statistical analysis of the micrographs was made. The angular dependence of the torque in Permalloy films has been studied. In films with h_c, the ratio of coercive force to anisotropy field, less than 0.5, the results agree very well with the formulas for magnetization reversal in an infinite cylinder. When $h_c > 0.5$, the situation appears very complex. The unidirectional hysteresis observed in this range can be understood very well if the existence of regions with negative anisotropy is assumed. Various methods of determining the anisotropy have been compared, and a torque technique for measuring dispersion in both magnitude and direction developed. The anisotropy found in films as a function of the angle-of-incidence of the evaporation beam and the anisotropy in epitaxially grown films is reported. The use of a vibrating sample magnetometer to determine the hysteretic properties of thin films is discussed. Author

N63-15859 Mechanical Technology, Inc., Latham, N.Y.
APPLICATION OF ROLLING ELEMENT COASTDOWN TECHNIQUES TO THE DETERMINATION OF LUBRICANT PROPERTIES
S. F. Murray Apr. 8, 1963 30 p 2 refs
(Contract Nonr-3729(00)(FBM))
(MTI-63TR13)

Coastdown characteristics were measured for lubricated ball bearings in order to evaluate the lubricants. As a previous study was made of oils of high viscosity, emphasis was placed on oils of a more reasonable bulk viscosity. Heavier rotors were used to increase the inertia of the rotating members, but this did not contribute to the accuracy of the data. Radial rather than thrust loaded bearings were used, but this made very little difference in the results obtained. Windage losses were eliminated by evacuating the system during the coastdown period. This increased the coastdown time. J.A.J.

N63-15862 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPLICATIONS NOTES: SELECTED WELDING TECHNIQUES
Washington, NASA Apr. 1963 31 p
(NASA SP-501) GPO: $0.30

Tools and techniques developed by the George C. Marshall Space Flight Center for the welding of aluminum plates and sheets are described. A seam tracker device and proximity control unit proved effective in welding heavy-gage aluminum. Two segmented backup bars provide most of the back-bar functions. A special vacuum-type backup bar facilitates repairs in normally inaccessible locations. Tape retains and shapes the molten underbead without weld contamination and proves useful for backup tasks. Handy fitup tools for fusion welding hold workpieces in near-perfect alinement. Alinement of large-diameter cylinders is maintained by direct-current straight-polarity TIG tack welding. Guide tips are developed for feeding fiber wire when welding with inert gas processes. Improved method of electric-arc spot welding utilizes the sigma technique. N.E.A.

N63-15883 Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.
MATERIALS PROPERTY DATA Phase I Quarterly Progress Report No. 4; Phase II Twelve Month Summary Report
James W. Yates Apr. 1962 50 p
(Contract AF 33(616)-8086)

The data contained in this report cover the areas of high-temperature–high-friction materials, corrosion-resistant materials, and high-temperature protective coatings. Author

N63-15897 Rock Island Arsenal Lab., Ill.
EFFECT OF CURE CONDITIONS ON WEAR LIFE AND CORROSION PROTECTION OF A RESIN-BONDED SOLID FILM LUBRICANT
F. S. Meade and G. P. Murphy Mar. 26, 1963 21 p 9 refs
(RIA-63-959) OTS: $0.50

A resin-bonded solid-film lubricant was applied to grit blasted steel, zinc phosphatized steel, and preheated zinc phosphatized steel. The coating was then cured at temperatures from 200° F to 500° F for times ranging from 10 to 180 minutes. The effect of these cure conditions on wear life and corrosion protection was determined. The following information was obtained from this investigation: (1) Grit blasted steel is inferior to the other two substrates. (2) At cure temperatures above 300° F, the resin-bonded solid-film lubricant does not prevent the loss of water of hydration from the zinc phosphate coating and the resultant loss in corrosion protection. (3) No one set of cure conditions gives optimum wear life and corrosion protection. (4) Wear life increases with increasing cure time and temperature. (5) Corrosion protection increases with decreasing cure time and temperature. (6) Cure conditions depend on the application for which the resin-bonded solid-film lubricant is to be used. Author

N63-15899 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
DIELECTRIC PROPERTIES OF SOME COMMON HIGH EXPLOSIVES
Edmund E. Walbrecht May 1963 15 p
(PA-TM-1170)

Primary emphasis is placed on the feasibility of using dielectric heating for determining induction times. Various electrical properties of certain high explosives, such as resistivity, dielectric constant at both high and low frequencies, dissipation factor, and dielectric strength, are calculated. Explosives measured included PBX, TNT, Composition B, Baratol, Octol, and PBX-9404. The specification number and composition of these explosives are given as well as the method for fabricating them. N.E.A.

N63-15927 International Union of Pure and Applied Chemistry
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, NUMBER 1, JANUARY, FEBRUARY, MARCH 1963
J. J. Diamond (Natl. Bureau of Standards), ed. [1963] 60 p 636 refs

N63-15955 Ohio State U. Research Foundation, Ohio
X-RAY IMAGE SYSTEM FOR NONDESTRUCTIVE TESTING OF SOLID PROPELLANT MISSILE CASE WALLS AND WELDMENTS Quarterly Progress Report No. 3
Robert C. Mc Master, Jay P. Mitchell, and Merle L. Rhoten Watertown Arsenal Labs., Mar. 1962 40 p 4 refs
(Contract DA-33-019-ORD-3383)
(WAL-TR-142.5/1-3)

A television X-ray image enlargement system has been developed for in-motion examination of missile case materials and weldments. Imaging tests of steel materials indicate that a two-percent penetrameter contrast sensitivity can be obtained up to 1/4-inch thickness with 1/1000-inch-detail resolution. Resolution tests of thin materials and wire meshes indicate that wire diameters down to 5/10,000-inch can be visualized on the television monitor screen. Author

N63-15969 Battelle Memorial Inst., Columbus, Ohio
EFFECT OF HIGH BORON BURNUPS ON B_4C AND ZrB_2 DISPERSIONS IN Al_2O_3 AND ZIRCALOY-2
Richard J. Burian, Earle O. Fromm, and John E. Gates Apr. 24, 1963 42 p 8 refs
(Contract W-7405-eng-92)
(BMI-1627) OTS: $1.00

Various types of dispersions of B_4C in Al_2O_3 and Zircaloy-2 and ZrB_2 in Zircaloy-2 were irradiated at temperatures of about 400° to 500° F to boron-10 burnups of 81 to 96 percent. The variables investigated included boron loading in the range of 2.7 to 4.8 volume percent, particle size, matrix density, and fabrication methods. The irradiated Al_2O_3-matrix pellets increased in diameter from 1.5 to 3.3 percent and released from 1.3 to 2.6 percent of the helium formed. The matrix contained a network of cracks connecting all B_4C particles. During a corrosion test of three pellets in 600° F reactor-grade water the pellets disintegrated. Variations in the parameters investigated did not affect the radiation stability of these dispersions. The irradiated Zircaloy-2-matrix pellets were unchanged except that boride particles at the pellet surfaces were swollen. Pellets containing B_4C exhibited little change in diameter while those containing ZrB_2 exhibited up to 0.3 percent increase in diameter. Helium release from both types of Zircaloy-2-matrix pellets could be accounted for by recoil from boride particles in the pellet surfaces. The pellets exhibited good helium retention

during postirradiation heating up to 1000° F and excellent resistance to corrosion by 600° F reactor-grade water. The Zircaloy matrix around each B_4C particle exhibited an area of visible damage, presumably from recoil atoms. Author

N63-15997 General Electric Co., Schenectady, N.Y.

A COMPARISON OF TWO SUPERCONDUCTIVE BEARING PRINCIPLES

T. A. Buchold *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 471–484 1 ref (See N63-15976 13-01)

Two design principles used in superconductive bearings are compared to determine which of them is more feasible for constructing bearings for cryogenic gyroscopes, accelerometers, and other cryogenic mechanical devices. The first keeps the total flux constant as the coil current changes with a changing bearing gap. The leakage flux of the coil circuit limits the bearing's stiffness. The second principle keeps the total ampere-turns constant when an additional fixed reluctance is inserted in the magnetic path. The bearing stiffness, easily made large by using small gaps in the bearing design, is not influenced by coil leakage. D.E.R.

N63-16000 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE VEHICLE TESTS AND MEASUREMENTS

Daniel H. Driscoll and Albert E. Schuler *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 535–560 (See N63-15976 13-01)

A condensed survey is presented of the principles, methods, and instruments used for ground measurement in rocket development and testing during the past 25 years. The following areas are covered: recording systems, pressure measurements, thrust and weight measurements, flow measurements, temperature measurements, and vibration and sound. R.C.M.

N63-16003 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PILOT MANUFACTURING FOR SPACECRAFT

Wilhem Angele *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 601–625 (See N63-15976 13-01)

This discussion of pilot manufacturing for spacecraft includes the following: materials and application problems, tools and equipment, frictionless bearings, airscrew accelerometer, heavy load bearings, floating support, and printed cables and connectors. It is concluded that the manufacturing engineer must be prepared to handle new problems in many new fields, including nuclear devices, cryogenic instruments, and solid-state microminiaturized electronics. R.C.M.

N63-16055 Linde Co. Div. of Union Carbide Corp., Tonawanda, N.Y.

MULTIPLE LAYER INSULATIONS

D. I-J. Wang *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 95–110 7 refs (See N63-16051 13-13)

This paper presents a theoretical analysis of multilayer insulation, compares the results of this theoretical analysis with experimental results, and gives applications for the insulation. A multiple layer insulating system comprises three essential elements, highly reflective shields, low-conductivity fibers to separate the shields, and a vacuum. In such an insulation, heat is transported by gaseous conduction, solid (or filler) conduction, and radiation. Equations for relating thermal conductivity of gas, solid, and radiation and insulation materials are derived. An assemblage of approximate equations, together with a correction factor permits predicting the thermal performance of a multiple layer insulation without need of much experimental data. The only data needed for the multiple layer system is the relation between compression and specific gravity of the filler. This information is "mechanical" in nature and can be obtained by observing the thickness of a given quantity of insulation under different compression loads. N.E.A.

N63-16056 Bell Aerosystems Co., Buffalo, N.Y.

THERMAL PROTECTION WITH A TEMPERATURE CAPABILITY TO 2500° F FOR COOL STRUCTURES

John A. Dickson *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 111–134 6 refs (See N63-16051 13-13)

Radiative heat dissipation is discussed for a system that maintains a primary airframe structure at a low temperature. It is shown that it is desirable to operate an airframe thermal protection system at the highest practical surface temperature so as to radiate the maximum portion of aerodynamic heating. The practical limit is determined by the materials that can be used for the outer, radiating surface. This discussion is limited to systems with a temperature capability of 2500° F. Materials are available for use up to 2500° F, and have been used to fabricate protection systems. In the area of double wall construction, radiative heat protection systems for insulated and cooled structures show a high degree of development. N.E.A.

N63-16063 Battelle Memorial Inst., Columbus, Ohio

DEVELOPMENT OF MATERIALS FOR THE THERMAL ENVIRONMENT

William J. Harris, Jr. *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 333–343 (See N63-16051 13-13)

Material research in relationship to aerodynamically heated structures is discussed with emphasis on problems in and challenges to the fields of engineering, design, and material research and development. Attitudes and approaches to problems and materials that have applications to the design of aerodynamically heated structures are reviewed. N.E.A.

N63-16075 Boeing Co. Transport Div., Renton, Wash.

THE EFFECTS OF STRESS CORROSION ON HIGH STRENGTH STEEL ALLOYS Quarterly Progress Report No. 2, Sept. 1, 1962-Dec. 1, 1962

W. C. Gallaugher and G. A. Dreyer Dec. 15, 1962 43 p 2 refs (Contract AF 33(657)-8705)
(Doc. D6-4080-2)

The effect of various processing variables on the stress-corrosion susceptibility of several high-strength steels is to be evaluated by stressing and alternately immersing steel specimens in a 3.5% NaCl solution. The variables to be studied include alloy form, ausforming, straightening, heat treatment, grain direction, strength level, welding effects, and protective coatings. The steels to be evaluated are AFC 77, AM 355, AM 350, 17-4PH, 18-7-5, 18-9-5, Ladish D6A, 4335M, 4340, 9% Ni+Co, and H-11. Author

N63-16084 Boeing Co. Seattle, Wash.

ROAD TRANSPORT DYNAMICS

R. W. Hager and E. R. Conner *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 This paper was not presented at Symp. (See N63-16076 13-33)

An analytical approach for the dynamic design of road transport vehicles is described and illustrated for the case of the Minuteman Missile Transporter-Erector. Details are also given of road-roughness criteria and test methods. Author

N63-16097 Naval Ordnance Lab., Corona, Calif.
DATA EXCHANGE PROGRAMS CONDUCTED BY U.S. NAVAL ORDNANCE LABORATORY, CORONA, CALIFORNIA
S. Pollock *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 261–275 This paper was not presented at Symp. (See N63-16076 13-33)

The purpose of this paper is to describe four separate and distinct reliability data exchange programs being conducted by the Naval Ordnance Laboratory, Corona, California. These are: the Fleet Ballistic Missile Weapon System (POLARIS) Component Reliability History Survey; the Interservice Data Exchange Program; the Bureau of Naval Weapons Guide Missile Data Exchange Program; and the Failure Rate Data Exchange Program. N.E.A.

N63-16109 Massachusetts Inst. of Tech. Surface Lab., Cambridge
FRICTION AND WEAR AT ELEVATED TEMPERATURES [Interim Report]
Ernest Rabinowicz and Masaya Imai Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 41 p 16 refs
(Contract AF 33(616)-7648)
(WADC-TR-59-603, Pt.IV)

Measurements have been carried out of the friction coefficient as a function of temperature using surfaces of stainless steel covered by low-melting metals and nonmetals applied in powder form. Some work has also been done with a few other metal and nonmetal surfaces. In cases where the interaction between the low melting substance and sliding surface is high, as revealed by the occurrence of wetting, the friction reaches a peak just below the melting temperature of the substance, and then drops to considerably lower values just above the melting point. The peak below the melting temperature is associated with the formation of large adhering fragments of the low melting substance on the sliding surface. When there is no wetting, the low-melting substance has, either below or above its melting point, essentially no effect on the friction. Author

N63-16154 Massachusetts Inst. of Tech. Instrumentation Lab., Cambridge
APOLLO GUIDANCE AND NAVIGATION. RELIABILITY HANDBOOK FOR ELECTRONIC DESIGNERS
G. W. Mayo, Jr. and E. T. Driscoll Aug. 1962 60 p
(NASA Contract NAS9-153)
(R-368) OTS: $5.60 ph, $2.00 mf

This reliability manual offers the engineer the tools and instructions for estimating circuit probabilities at the time when component parts and applications are first considered. Parts-application notes, a listing of recommended parts, and an example of reliability prediction and failure-rate curves of high-use items have been included. N.E.A.

N63-16155 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SPACE MECHANISM FOR LIMITED PARALLEL MOTION
A. C. Dunk Dec. 14, 1962 17 p 4 refs
(NASA Contract NAS7-100)
(JPL-TM-33-106) OTS: $1.60 ph, $0.80 mf

The design of a space mechanism using deformable elastic connections is described. The mechanism constrains the output link to describe parallel planes. Some advantages of this type of linkage in applications involving research in space are discussed. Author

N63-16191 Horizons Incorporated, Cleveland, Ohio
STUDIES OF THE REINFORCEMENT OF METALS WITH ULTRA HIGH STRENGTH FIBERS (WHISKERS) Interim Report No. 4, June 1–July 31, 1962
Bertram C. Raynes, Robert H. Kelsey, and Eugene Wainer Sept. 28, 1962 20 p
(Contract NOw-62-0235-c)

The reinforcement of pure hydrogen-reduced iron by alumina fibers has been shown, both at room temperature and at 900° F. Stainless steel has been found to wet alumina fibers in an argon atmosphere, and the possibility of direct reinforcement is indicated. Melting of prealloyed metal powders on high-purity dense sintered alumina disks has shown the presence of excessive amounts of oxides, some of which attack the alumina. These have been shown to be present in the metal powder. Author

N63-16250 Aeroprojects, Inc., West Chester, Pa.
INVESTIGATION OF ULTRASONIC WELDING OF REFRACTORY METALS AND ALLOYS Bimonthly Progress Report No. 1, Aug. 16–Oct. 16, 1962
Nov. 1962 8 p 2 refs
(Contract NOw 63-0125-C)

Preliminary specifications for Power-Force Programming (PFP) control circuits and the tentative design for a system have been established. PFP components have been secured, and a 4-kilowatt spot welder has been modified to operate with them. Efforts have been expended in securing an adequate source of refractory metals, and probative meetings have been established with manufacturers relative to material composition and processing techniques. Author

N63-16299 Aro, Inc., Arnold Air Force Station, Tenn.
OPERATIONAL EVALUATION OF DRY-LUBRICANT COMPOSITES IN A HIGH VACUUM CHAMBER
A. G. Williams, and T. L. Ridings Arnold Engineering Development Center, May 1963 46 p 3 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-67)

This report contains the results of a test program to determine the operational characteristics of dry self-lubricating materials in the extremely low-pressure environment of a space simulator. The test was designed to evaluate the lubrication of gears, pinions, and bearings. Four selected self-lubricating composites fabricated as bearing retainers and idler gears were tested in the 7-ft aerospace research chamber at AEDC. Three of the composites consisted of a metal matrix, polytetrafluoroethylene (PTFE), and tungsten diselenide (WSe_2); the other consisted only of PTFE and WSe_2. The three composites with the metal matrix performed satisfactorily; the fourth material did not provide an adequate lubricating film on the gears which resulted in metal-to-metal contact and high wear. Author

N63-16306 Virginia U. Research Labs. for the Engineering Sciences, Charlottesville
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Progress Report, Dec. 1, 1952–Feb. 28, 1963
B. J. Gilpin Mar. 1963 31 p 4 refs
(Contract AF 33(657)-8352)
(EMI-4454-111-63U)

Included in this quarterly report are: (1) the efforts to increase radial damping in the passive radial-bearing system; (2) the investigation of the difference between the two active directions of the radially active magnetic-bearing system and a description of the newly designed system; (3) the preliminary testing of the magnetic resonant bearing system with further analytical and experimental studies of a magnetic resonant support system with small intrinsic damping; and (4) the completion of the mechanical components of an electrical resonant bearing system. Author

N63-16314 Mechanical Technology, Inc., Latham, N.Y.
INVESTIGATION OF COMPLEX BEARING AND/OR LUBRICATION SYSTEMS First Quarterly Progress Report [May 1, 1962-Aug. 1, 1962]
P. Lewis, S. F. Murray, and M. B. Peterson Aug. 5, 1962 67 p 7 refs
(Contract AF 33(657)-8666)
(MTI-62TR14)

Progress is reported in evaluating complex bearing and/or lubrication systems for flight accessory equipment that operates at temperatures from −60° to 1500° F, in high vacuum or normal atmosphere, and during exposure to nuclear radiation. Two systems have been selected for further study on the basis of materials availability and adaptability to the combined-system concept: (1) the solid-lubricated rolling element bearing and (2) the externally pressurized gas bearing. M.P.G.

N63-16322 Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
ELECTRON BEAM WELDING OF AEROSPACE MATERIALS [Final Report]
William I. Kern and Lawrence E. Lubin Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 191 p 6 refs
(Contract AF 33(657)-7763)
(ASD-TDR-63-132)

High-voltage electron-beam welding techniques capable of producing butt welds of optimum strength and ductility were developed for B120VCA titanium, D6AC steel, molybdenum-0.5% titanium to tungsten, and beryllium. Welds were produced in material thicknesses of 0.125 inch for the B120VCA titanium; 0.290 inch and 0.090 inch for the D6AC steel; 0.100 inch, and 0.050 inch, and 0.005 inch for the molybdenum-0.5% titanium welded to tungsten; and 0.040 inch for the beryllium. The effects of thermal treatments (aging and heat treating) were investigated in the B120VCA and D6AC by welding and testing a variety of weld-thermal treatment combinations. Results of the metallographic and mechanical property investigations of the electron beam welds were compared with base-metal properties and with published data for other joining techniques. Author

N63-16333 General Motors Corp. New Departure Div., Bristol, Conn.
RESEARCH AND DEVELOPMENT OF AIRFRAME BEARINGS FOR AEROSPACE VEHICLES Progress Report No. 4, Feb. 1, 1963-Apr. 30, 1963
R. J. Matt, J. B. Muratore, R. E. Murteza, and C. J. Zupkus May 7, 1963 68 p 10 refs
(Contract AF 33(657)-8431)

Al_2O_3 and Ta_2Be_{17} have been selected for further testing. Six dry film lubricants have been selected. A total of 100 of the scheduled 192 Phase 2 tests have been completed. Results indicate no improvement in performance with the use of lubricants, except for isolated cases at specific temperatures. The ultra-high-vacuum test chamber has been tested under clean and dry conditions and produced a vacuum in the 10^{-10} torr range. The specimen test-rig components for the Phase 3 effort are presently being installed in the vacuum chamber. Author

N63-16334 North American Aviation, Inc., Columbus, Ohio
HIGH ENERGY RATE METAL WORKING BIBLIOGRAPHY Final Report, Jan. 1, 1960-Jan. 1, 1962
Daniel E. Strohecker Jan. 15, 1962 235 p 478 refs
(NA62H-46)

This final report is a bibliography with abstracts of articles on, and related to, high-energy rate metal working, and covers the survey work performed over the period from 1 January 1960 to 1 January 1962. The subjects and categories covered in this bibliography are: (1) Safety, (2) Energy Sources, (3) Energy Transfer Mediums, (4) Facilities and Equipment, (5) High-Energy Rate Forming, (6) High-Energy Rate Machining, (7) Theory of High-Energy Rate Phenomenon, (8) High-Energy Rate Welding, and (9) Work Hardening by High-Energy Rate Methods. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: **07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.**

N63-15772 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTIVENESS OF SINGLE ALUMINUM METEOROID BUMPERS
Donald H. Humes Washington, NASA, May 1963 25 p 4 refs
(NASA TN D-1784) OTS: $0.75

An experimental investigation of the effectiveness of single aluminum meteoroid bumpers has been made. For impact velocities up to 15,000 ft/sec, the penetration of 0.062-inch-diameter copper spheres into aluminum targets can be greatly reduced by using a properly selected bumper placed an adequate distance from the main wall. In the velocity range of this investigation, there was a limit to the depth to which some bumper-protected targets were penetrated that occurred at a relatively low impact velocity, the lower velocity projectiles producing deeper penetrations than the higher velocity projectiles. The effectiveness of the bumper against the higher velocity projectiles was caused by the shattering of the projectiles as they penetrated the bumper at these velocities and by the dispersion of the resulting fragments over a large area of the main wall. The degree of fragmentation was a function of the impact velocity. The limit to which the aluminum bumper-protected targets were penetrated by copper spheres is a function of the bumper thickness. The optimum bumper thickness was between 0.5 and 2.0 times the diameter of the impacting projectile. At velocities great enough to cause fragmentation of the projectile, the penetration decreased with increased bumper standoff distance, up to a point, beyond which further increases in the bumper standoff distance had no effect on the penetration. A standoff distance greater than 8 projectile diameters was required to limit penetration in a bumper-protected target. Author

N63-15790 Battelle Memorial Inst., Columbus, Ohio
EFFECT OF HEAT TRANSFER ON CORROSION OF FERROUS ALLOYS IN BOILER WATERS
Warren E. Berry and Frederick W. Fink Apr. 16, 1963 33 p 98 refs
(Contract W-7405-eng-92)
(BMI-1626) OTS: $0.75

A survey has been made of the effect of heat transfer on the corrosion behavior of ferrous alloys in boiler waters, particularly as applied to liquid-metal-heated steam generators. The results have shown that ferrous-alloy boiler tubes may fail during operation—from general corrosion, oxygen pitting, on-load pitting, caustic embrittlement, chloride stress-corrosion cracking, or corrosion fatigue. All of these forms of corrosion, except on-load pitting, can be avoided by appropriate changes in design, operation, or boiler-water treatment. On-load pitting appears to be related to heat-transfer conditions, but its cause is not yet known. Heat transfer appears to affect corrosion behavior by raising the metal

surface temperature, concentrating corrosive solids in the boiler water, releasing corrosion-promoting gases from solution, or providing thermal gradients in the metal and protective oxide film. Author

N63-15831 Western Gear Corp. Systems Management Div., Lynwood, Calif.

HIGH ENERGY RATE FORGING DEVELOPMENT Third Interim Technical Progress Report, Dec. 10, 1961 to Feb. 10, 1962

J. M. Palsulich and R. H. Hall Feb. 1962 51 p 4 refs
(Contract AF 33(600)-42523)
(Rept. 622-206; AMC-TR-7-866(III))

Physical property tests on high-energy-rate forged upsets from PH15-7Mo steel indicate that it is possible to achieve excellent ductility in both longitudinal and transverse directions. Materials studied were AISI 4340, Ti-6Al-4V, H-11 Tool Steel, and PH15-7Mo. Forging parameters for scissors and bracket configurations were established. Author

N63-15838 Michigan U., Ann Arbor

STRAIN DISTRIBUTION ON NOTCHED PLATE SPECIMENS AT CREEP TEMPERATURES [Final Report, July 1, 1960-Dec. 31, 1961]

Howard R. Voorhees and James W. Freeman Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Aug. 1962 57 p 11 refs
(Contract AF 33(616)-7416)
(ASD-TDR-62-710)

Resistance strain gages and grids of vapor-deposited metal were evaluated for measuring strains at loading and during creep in plates with edge notches. Foil strain gages mounted with thermal-setting cements remained usable to 0.5% or higher strain at 500° F, but indicated creep was first less than, and later more than, optical-extensometer readings. Indications from gages mounted with ceramic cement drifted 10μin./in./hr. at 1200° after several hundred hours at temperature, but agreed with the extensometer to one percent strain. Qualitative measurements were made during loading (K_t 1.8 and 3.6) and for creep (K_t 1.8) of M-470 alloy at 500° F. Plastic strains were too small to determine by the grid lines used. Author

N63-15854 Watertown Arsenal Labs., Mass.

EFFECT OF SOLIDIFICATION VARIABLES ON MECHANICAL PROPERTIES OF CAST STEEL

David A. Colling and Paul J. Ahearn July 1962 23 p 8 refs
(WAL-TR-311.1/1)

True-stress–true-strain measurements of specimens from modified AISI 4340 steel cylindrical castings show variations in mechanical properties with respect to solidification time; tensile strength is reduced somewhat by increased solidification time, and there is considerable corresponding loss of ductility. It is shown that the influence of freezing time changes through the casting radius. For short freezing times, only ductility is affected, but for longer freezing times, ductility and tensile strength are affected. Specimens from selected castings are examined using an electron-beam microanalyzer. It is shown that microsegregation is equally severe in small distances across equiaxed grains as it is for much greater distances along dendrite arms in columnar grains. No apparent reduction in heterogeneity is obtained by homogenizing treatments. Microporosity distribution exhibits maxima at the end of columnar growth and at the casting center. Minimum microporosity in each casting is obtained near the surface; however, the level of microporosity is considerably influenced by external pressure during solidification. The loss of ultrahigh-strength steel properties with increased solidification time appears to be somewhat dependent upon nonmetallic inclusions and is strongly affected by other factors, including microsegregation and microporosity. Author

N63-15858 Martin Co., Baltimore, Md.

EFFECTS OF SURFACE ENVIRONMENTS ON THE MECHANICAL BEHAVIOR OF METALS [Final Report]

I. R. Kramer Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Aug. 1962 52 p 17 refs
(Contract AF 33(616)-7976)
(ASD-TDR-62-99)

A study of the mechanical behavior of copper single crystals in solutions containing surface-active agents shows that the weakening effect is associated with the formation and solution of metallic soaps. A large change in the stress-strain characteristics of polycrystalline aluminum alloys was found when the surface of the specimens was removed during plastic deformation. Studies of the effect of size of the specimen on the changes of slopes of Stages I and II by surface removal showed that the change of the slope of Stage I was independent of size with respect to the polishing rate; however, the change in the slope of Stage II with polishing rate increased directly in proportion to surface area or cross section. A surface-removal treatment on single crystals eliminated the yield point, whereas the same type of treatment enhanced the yield point drop on aluminum alloys. Measurements of slipband spacing indicate that surface treatment affects the egress of dislocations. Author

N63-15870 Aeronautical Research Labs., Melbourne (Australia)

ABNORMALLY HIGH FATIGUE PROPERTIES OF D.T.D. 683 ALUMINUM ALLOY EXTRUDED BAR

J. M. Finney Feb. 1962 37 p 21 refs
(ARL/SM-287)

Unnotched and notched rotating cantilever fatigue tests on extruded D.T.D. 683 aluminum-alloy bar have indicated fatigue strengths considerably greater than those usually reported for material to this specification. The maximum fatigue-strength-reduction factor obtained was less than 2.0, although the range of K_t values employed was from 1.45 to greater than 10. The material investigated is thus of low fatigue-notch sensitivity. Also, the S-N curves for notched specimens of K_t = 1.45, 2.35, and 3.80 were of unusual shape, exhibiting an inflexion near 10^6 cycles. No suitable explanation for such behavior has yet been found. All unnotched specimen fractures developed at an angle of approximately 40° to the specimen axis although, in most cases, the initial portion of the fracture was in a transverse direction. The characteristics of fracture of notched specimens depended markedly on endurance. Above 10^5 cycles, all notched specimen fractures were similar, being of a coarse appearance but transverse to the specimen axis. At less than 10^5 cycles, specimens of K_t = 1.45 and 2.35 gave "cup and cone" type fractures, while those of specimens of K_t = 3.80, 5.20, and greater than 10 were smooth and transverse. Residual stresses are considered to be important as regards the actual path of propagation of the fatigue crack and the resulting fracture appearance. Author

N63-15878 Solar, San Diego, Calif.

DEVELOPMENT OF LOW TEMPERATURE BRAZING ALLOYS FOR TITANIUM HONEYCOMB SANDWICH MATERIALS [Final Report, Dec. 1, 1961-Nov. 30, 1962]

W. C. Troy Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 49 p 3 refs
(Contract AF 33(616)-7249)
(ASD-TR-61-313, Pt. II)

For brazing titanium under 1100° F, binary information formed the basis of selecting two promising ternary basis alloys for development: Ag-Cu-Ge and Ag-Cu-Sn. Melt and flow behavior was favorable with Ag-Cu-Sn base alloys, but work was discontinued because of excessive joint brittleness related to intermetallic films formed on the substrate. Alloys based on the Ag-Cu-Ge ternary also formed intermetallic films, but the joints had intermediate strength which justified evaluation. Average shear strength of lap

joints varied from 10,750 psi for aged specimens to 11,900 psi for specimens after brazing at 1100° F. These marginal properties would justify only limited application of the Ag-Cu-Ge base alloys. Author

N63-15880 Little (Arthur D.), Inc., Cambridge, Mass.

KINETICS OF OXIDATION OF REFRACTORY METALS AND ALLOYS AT 1000° C-2000° C [Final Report, Sept. 1959-July 1962]

J. B. Berkowitz-Mattuck Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 118 p 55 refs

(Contract AF 33(616)-6154)

(ASD-TDR-62-203, Pt. II)

A thermal-conductivity apparatus for continuous measurement of oxidation of metallic materials between 900° C and 2100° C is described. Results on the oxidation of copper between 975° C and 1044° C at oxygen partial pressures of 2 to 10 torr are in agreement with literature values obtained by conventional methods. Experimental data are discussed in the light of thermodynamic considerations for the carbides of groups IV-A, V-A, and VI-A metals. The oxidation of Mo_3Si, Mo_5Si_3, and $MoSi_2$ between 1300° K and 2100° K at oxygen partial pressures of 2 to 20 torr was studied by oxygen consumption and metallographic techniques. The oxidation of W_5Si_3 and WSi_2 was studied by the thermal conductivity method at temperatures between 1600° K and 2030° K. A measurement of the rate of oxidation of Ta_2Be_{17} was made at 1664° K and 8.4 torr. Author

N63-15881 Westinghouse Electric Corp., Blairsville, Pa.

VACUUM ARC MELTING OF TUNGSTEN +0.6 COLUMBIUM [Final Report, Aug. 1, 1962-Feb. 28, 1963]

George A. Reimann Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 93 p 11 refs

(Contract AF 33(616)-7459)

(ASD-TDR-63-296)

Vacuum arc-melting techniques were developed to produce sound 3½-inch- and 4-inch-diameter ingots of tungsten-base alloys. The effect of melting rate on ingot characteristics was determined; and the effects of carbon, oxygen, zirconium and titanium on melting characteristics, ingot structure, extrudability, recrystallization, and high-temperature tensile properties of the W+0.6%Cb alloy were studied also. Refinement of ingot structure was produced by 0.06 and 0.12% zirconium additions and by increasing the melting rate. Coarsening of ingot structure was produced by 0.04% titanium and 500 to 1000 ppm oxygen additions. W+0.6Cb ingots containing more than 50 ppm carbon could not be extruded, and correlation between extrudability vs. carbon content below 50 ppm was not found. Adding 0.12% zirconium to the W+0.6Cb alloy significantly improved the 3000° F tensile properties. Author

N63-15926 National Engineering Lab., East Kilbride (Gt. Brit.)

COMPLEX-STRESS CREEP, RELAXATION, AND FRACTURE OF METALLIC ALOYS

A. E. Johnson, J. Henderson, and B. Khan Edinburgh, HMSO, Feb. 1962 83 p 39 refs

Available from HMSO: 7s 6d

Investigations being carried out by Dr. A. E. Johnson and his colleagues since 1932 on the complex-stress creep, relaxation, and creep-fracture characteristics of a range of alloys at temperatures within their normal working range are summarized. B.J.C.

N63-15940 Thompson Ramo Wooldridge, Inc., TAPCO Div., Cleveland, Ohio

STRAIN AGING AND DELAYED FAILURE IN HIGH-STRENGTH STEELS [Final Report], Oct. 15, 1961-Oct. 14, 1962

E. A. Steigerwald and G. L. Hanna Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Nov. 1962 56 p 29 refs

(Contract AF 33(657)-7512)

(ASD-TDR-62-968)

Spontaneous strain aging which occurs during tensile testing was examined for several high-strength steels. The results of smooth and notch tensile tests indicated that significant strain aging effects occurred in most high-strength steels in the 300° F to 800° F temperature range and this behavior was analogous to "blue brittleness" in mild steels. Constant-load, stress-rupture tests were conducted on the steels to determine the possible relationship between strain-aging embrittlement and delayed failure. Only the 300-M steel tested at 400° F exhibited an appreciable degree of delayed failure. This embrittlement was extremely sensitive to test environment and was eliminated when tests were conducted in argon. Although strain aging was not a sufficient condition to initiate delayed failure, it appeared to increase the severity of the environmental effects in the particular range where sufficient interstitial mobility existed. Author

N63-15951 Israel Program for Scientific Translations, Ltd., Jerusalem

STRESS-CORROSION CRACKING OF METALS

V. V. Romanov 1961 156 p 160 refs Transl. by Ch. Nissenbaum of book "Korrozionnoe Rastreskivanie Metallov", Moscow, 1960 (OTS-51084) OTS: $1.50

Available data on stress-corrosion cracking of metals are systematized. The mechanism of the general theory and methods of investigating stress-corrosion are discussed. The influence of certain variables, i.e., polarization, stresses, alloying elements, and corrosive environments, on stress-corrosion cracking of metals are described. Stress-corrosion data on the following alloys are considered: ferrous, magnesium, aluminum, and copper (in an alkaline environment). N.E.A.

N63-15974 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge

THE STRENGTH AND PLASTICITY OF ANISOTROPIC METALS Second Quarterly Report

W. A. Backofen and W. F. Hosford, Jr. Dec. 31, 1962 29 p 11 refs

(Contract DA-19-020-ORD-5719)

(WAL-TR-834.12/2-1)

Tension tests have been made on strip specimens cut at different angles from textured sheets. For a pure titanium sheet, RC-70 annealed, the angular variation of yield stress and strain ratio do not agree with the predictions of Hill's anisotropic plasticity theory. Relatively low R values observed in magnesium alloy (AZ31B) sheets with strong (0001) textures are interpreted as resulting from basal slip. For cubic metals, a method is outlined for calculating the relationship of plastic anisotropy to crystallographic texture. The method, which is an extension of Taylor's analysis of plastic strains in polycrystalline metals, is used to predict the flow stress and strain ratio resulting from various textures. Author

N63-16045 Armour Research Foundation, Chicago, Ill.

INVESTIGATION OF FACTORS RELATED TO AN UNKNOWN PHASE IN B120 VCA TITANIUM ALLOY [Final Report, Apr. 15, 1961-Apr. 15, 1962]

David W. Levinson Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Oct. 1962 70 p 9 refs

(Contract AF 33(616)-8149)

(ARF-2222-12; ASD-TDR-62-534)

A study was made of the needle-like precipitate which had been observed to occur in B120 VCA as a result of welding or of solution treating at temperatures above 1100° C. The phase was found to be the alpha phase, stabilized by oxygen. Under conditions of strict oxygen exclusion the alpha needles do not appear. The embrittlement of material aged after either welding or overheating

during solution treatment was found to be unaffected by the alpha needles. Embrittlement occurred whether or not needles were present in the microstructure. Some evidence is presented which implies that omega phase precipitation may produce the embrittlement. Author

N63-16054 Martin Co., Baltimore, Md.
MATERIAL BEHAVIOR IN A RANDOM STRESS-TEMPERATURE-TIME ENVIRONMENT
C. J. Giemza *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 29-93 29 refs (See N63-16051 13-13)
(Contract AF 33(616)-6453)

An examination was made of the environmental creep behavior of bare 7075-T6 aluminum alloy sheet to develop an experimental approach as well as empirical relations for characterizing a material's response to an arbitrary stress–temperature–time environment, following a prior history during which a metallurgical change has occurred. To achieve generality, a technique called "random balance" was employed to select a representative group of test combinations which would faithfully represent an arbitrary environmental path. Creep strain was the only parameter which could continuously relate the instantaneous response of a material to a current stress and temperature and a prior history. Author

N63-16116 Pratt and Whitney Aircraft, East Hartford, Conn.
EFFECT OF SHOCK-INDUCED HIGH DYNAMIC PRESSURES ON IRON-BASE ALLOYS [Final Report, May 1, 1961-Feb. 28, 1962]
Stephen M. Silverman, Loren Godfrey, H. Alan Hauser, and Edward T. Seaward Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Aug. 1962 98 p 3 refs
(Contract AF 33(616)-8190)
(PWA-2050; ASD-TDR-62-442)

This investigation included a study of the effects of shock-wave duration, repeated shocks on a single test specimen, increasing shock-wave intensity, and postshock treatment on the yield and tensile strengths of H-11 tool steel and 25 percent nickel steel. As a result of explosive shock hardening, H-11 steel increased in yield strength from 235 ksi in the preshocked condition to 340 psi in the as-shocked (360 kilobars) condition, whereas the 25 percent nickel steel showed yield strength increases from 235 ksi in the austenitized-plus-aged condition to 255 psi in the shocked-plus-aged condition. These increases in yield strength were brought about without any significant macroscopic plastic deformation. Author

N63-16118 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
RESEARCH REACTOR FUEL ELEMENT CONFERENCE–BOOK 2, SEPTEMBER 17-19, 1962, GATLINBURG, TENNESSEE
[1962] 368 p 92 refs
(Sponsored by AEC and Oak Ridge Natl. Lab.)
(TID-7642, Bk. 2) OTS: $7.50 for Books 1 and 2

The following papers were presented at the Research Reactor Fuel Element Conference: A New Concept for Aluminum Fuel Elements, Fabrication of Composite Plate Assemblies Containing Graded or Contour Fuel and/or Poisson Loadings by Powder Metallurgy Techniques, Fabrication and Radiation of Bonded Flat Type Rods for the NRU Reactor, Performance of Aluminum–Uranium Alloy Fuel Plates Under High Temperature and High Burnup Conditions, Some Results of Uranium Aluminum Irradiations at the MTR/ETR, Radiation Performance and Induced Transformations in Aluminum-Base Fuels, Effect of Fuel Burnup on Aluminum Plates Reinforced with Fueled-Glass Fibers, Mechanical Properties of X8001 Aluminum Cladding and X8001 Aluminum-Base Fuel Dispersion at Elevated Temperature, Aluminum–Aluminum Oxide Alloy Wrought Products, Observations on the Thermal Stability of S.A.P., Aluminum Alloy Corrosion, The Corrosion of Aluminum Alloys under simulated ATR and HFIR conditions, Corrosion of Aluminum-Clad Fuel Elements, Exothermic Reactions in Al-U_3O_8 Composites, The radiation of Uranium Homogeneity Requirements to the Yield of Uranium–Aluminum Alloy Fuel Plates, Use of Chip and Sheet Methods for Producing Homogeneous Aluminum–Uranium Fuel, and Applications of Scintillation Spectrometry to Research Reactor Fuel Assay. N.E.A.

N63-16120 Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.
Progress Report for the Period 15 Oct. 1962-15 Apr. 1963 [FATIGUE OF METALS AND DEFORMATION OF PURE FCC CRYSTALS]
May 1, 1963 8 p
(Contract AF 33(616)-6418)
(Rept. 13)

Progress is reported for the following: investigating the migrational kinetics of point defects and defect-impurity atom complexes in pure iron and iron-carbon alloys; determining the effect of substitutional solutes on deformation of niobium; and analyzing crystals tested in a single system slip by increment loading and change-in-temperature creep tests, and at low shear strains by measuring the changes in flow stress with temperature and with strain rate. N.E.A.

N63-16161 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
PRELIMINARY INVESTIGATION OF MELTING, EXTRUDING, AND MECHANICAL PROPERTIES OF ELECTRON-BEAM-MELTED TUNGSTEN
Walter R. Witzke, Earl C. Sutherland and Gordon K. Watson Washington, NASA, May 1963 42 p 20 refs
(NASA-TN-D-1707) OTS: $1.25

Three tungsten ingots were prepared by the electron-beam-melting process. Billets machined from the ingots were successfully hot extruded in high- and low-velocity extrusion presses. The mechanical properties of the extruded electron-beam-melted tungsten were determined by tensile tests at temperatures from 70° to 3900° F. These data were compared to those of tungsten prepared by the powder-metallurgy process. Author

N63-16175 Colorado School of Mines Research Foundation, Inc., Golden
IMPROVED OXIDATION RESISTANCE OF MOLYBDENUM BY ALLOYING WITH RARE EARTH AND OTHER SELECTED METALS Interim Report No. 2, Jan. 1-Feb. 28, 1962
H. Gordon Poole, Fred L. Smith, and Wilbur J. Guay Mar. 28, 1962 6 p 1 ref
(Contract NOw-62-0305-d)

Oxidation experiments with Y and Sm showed that these metals formed the anion-deficit semiconductor type of oxide. Y-Zr alloys containing 1, 2, and 4 percent Zr were oxidized in an attempt to produce an oxide scale with less anion deficiency, and hence a lower oxidation rate in accordance with the Wagner-Hauffe concept. The results were negative. Author

N63-16176 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
MICROSTRUCTURE STUDIES OF POLYCRYSTALLINE REFRACTORY OXIDES Quarterly Progress Report No. 1, June 12-Sept. 12, 1962
T. Vasilos, R. M. Spriggs, and J. Mitchell Nov. 7, 1962 20 p 12 refs
(Contract NOw-62-0648-c)
(RAD-SR-62-219)

A mechanical testing machine was designed and constructed recently to determine the elastic modulus and modulus of rupture

for transverse bending of high-density alumina and magnesia at elevated temperatures. Log-log plots of room-temperature strength (extrapolated to zero porosity) versus grain size for alumina revealed the relationship: $S = 86{,}000\ G^{-1/3}$ (psi) where G = grain size in microns, and $S = 50{,}000\ G^{-1/6}$ (psi) for heat-treated specimens of magnesia. A large number of test specimens (>100) of dense alumina and magnesia have been fabricated with fine-grain microstructure (about 2 to 3 microns average size). Others are being machined from fabricated blanks, and specimens with larger grain size are being prepared by heat treating. Specimens prepared to date have an average grain size range of 2 to 130 microns. Author

N63-16177 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

MICROSTRUCTURE STUDIES OF POLYCRYSTALLINE REFRACTORY OXIDES Quarterly Progress Report No. 2

T. Vasilos, R. M. Spriggs, and J. B. Mitchell Feb. 14, 1963 23 p 14 refs

(Contract NOw-62-0648-C)

(RAD-SR-63-29)

Transverse bend strength and elastic modulus determinations made of fine-grained (1 to 2 micron), dense, pure Al_2O_3 and MgO specimens as a function of temperature (up to 1350° C) revealed values higher than those obtained by other investigators for these oxides in more porous form and of larger grain sizes. Studies of the grain-growth kinetics of alumina and magnesia were conducted in order to obtain information to enable preparation of specimens with desired larger grain sizes for subsequent thermomechanical testing. Based on observations of the fracture modes exhibited by alumina and magnesia as a function of temperature, it was suggested that anelastic deformation or possible plastic flow in the so-called "equicohesive" temperature range may influence the mode of fracture. By analogy with findings in metals systems, it was hypothesized that the apparent transition from transgranular to intergranular fracture might occur below some critical stress rather than above some critical temperature. Author

N63-16183 Watertown Arsenal Labs., Mass.

THE NOTCH PROPERTIES AND SHEAR TRANSITIONAL BEHAVIOR OF H 11 STEEL

Joseph L. Sliney and Fred Schmid Feb. 1963 30 p 13 refs

(WAL-TR-766.5/2)

A heat-treatment study was conducted on commercial, air-melted, 0.063-inch-thick H 11 steel sheet. Edge-notched tensile, center-notched crack propagation (G_c), and sheet Charpy impact specimens, which were tempered in the 600° F to 1100° F temperature range, all indicated the same general tempering behavior. Shear transition temperatures were determined as a function of sheet thickness (0.020 in. to 0.100 in.) using edge-notched tensile specimens ground to thickness from a 0.125-inch-thick sheet of H 11 steel after double tempering at 1075° F. Comments are made regarding relative toughness, fracture appearance, and the critical thickness concept as a function of test temperature. Steel sheet is not recommended for service use in thicknesses greater than the critical thickness at the lowest service temperature. Comments are included on the relative shear transitional behavior of air-melted and vacuum-melted H 11 and D 6 steel-sheet materials. Author

N63-16192 Armour Research Foundation, Chicago, Ill.

DEVELOPMENT AND APPLICATION OF A THEORY FOR PLASTIC DEFORMATION OF CEMENTED ALLOYS. TASK I: ZONE SWEEPING OF CEMENTED TUNGSTEN ALLOYS Summary Status Report, June 3, 1960–July 2, 1961

N. M. Parikh July 28, 1961 48 p

(Contract DA-11-022-505-ORD-3092)

(ARF-2182-24; WAL-TR-372/32-1)

A new method has been developed for fabrication of tungsten sheets by powder metallurgy. The method involves densification of tungsten by liquid-phase sintering in presence of nickel and iron and by subsequent removal of the low-melting matrix. The matrix removal is accomplished by zone refining at temperatures above the melting point of the matrix (>1450° C). The high-temperature (2000° C) mechanical properties of zone-refined tungsten bars compare favorably with those of commercial powder-metallurgy tungsten sintered at 2600° to 3000° C. Author

N63-16204 Battelle Memorial Inst., Columbus, Ohio

DEVELOPMENT OF PROCEDURES FOR WELDING 2-INCH-THICK TITANIUM-ALLOY PLATE Final Report

W. J. Lewis, G. E. Faulkner, and D. C. Martin July 31, 1962 42 p 5 refs

(Contract NOw-60-0390-c)

Procedures were developed for welding 2-inch-thick titanium alloy plate, i.e., A-70, Ti-5Al-2.5Sn, Ti-6Al-4V, and Ti-3V-11Cr-3Al alloys. Results show that heavy titanium-alloy plates can be satisfactorily welded provided that they are adequately protected from weld contamination and that the compositions of the filler wire and base plate are properly controlled. A controlled-atmosphere welding chamber was used to provide protection for the welds. However, similar results can be expected in open-air welding operations if adequate shielding methods are developed for protecting welds from contamination. N.E.A.

N63-16227 Massachusetts Inst. of Tech., Cambridge

PROGRESS REPORT, SEPTEMBER 1, 1962–FEBRUARY 28, 1963

Jens G. Rasmussen, Michio Yamazaki, and Nicholas J. Grant [1963] 19 p

(NASA Grant NsG-117-61)

(DSR-8692) OTS: $1.60 ph, $0.80 mf

Progress is reported in studies of (1) oxide stability in Cu-SiO_2 and Cu-Al_2O_3 alloys; (2) the mechanism of internal oxidation in dilute nickel alloys; (3) preparation of oxide-dispersion-strengthened nickel-molybdenum alloys using decomposition and selective reduction methods; and (4) preparation of alumina-dispersion-strengthened copper-nickel alloys by internal oxidation. M.P.G.

N63-16264 Aerojet-General Corp. Ordnance Div., Downey, Calif.

THE EFFECT OF ε-CARBIDE ON THE PASSIVITY OF STEEL IN NITRIC ACID SOLUTIONS Appendix C

T. G. Owe Berg *In its* Study of Susceptibility of Solid Composite Propellants to Explosion or Detonation Final Report, Apr. 12, 1963 p 1–13 38 refs (See N63-16261 13-26)

(Rept. 0253-05(18)QP)

Carbon steels of 0.10% C, and 0.95% C were heat treated to produce ferrite + cementite, martensite, and martensite tempered at 200° C. Specimens were immersed in nitric-acid solutions of various concentrations, and the minimum concentration required for passivation was determined. This concentration depends upon the amount of hydrogen-rich phase, ε-carbide, in the specimen. Steel containing ferrite + cementite alone is passivated by 7.2 N acid, steel containing tempered martensite at a higher concentration, and steel containing untempered martensite at a still higher concentration. The results are related to other observations with dissolution and etching of steel in nitric acid and with ε-carbide. Author

N63-16296 National Aeronautics and Space Administration, Washington, D.C.

PROGRESS REPORT OF THE NASA SPECIAL COMMITTEE ON MATERIALS RESEARCH FOR SUPERSONIC TRANSPORTS

Richard H. Raring, J. W. Freeman, J. W. Schultz, and V. R. Voorhees (Michigan U.) May 1963 191 p 3 refs

(NASA TN-D-1798) OTS: $3.50

Activities of the NASA Special Committee in Materials Research for Supersonic Transports during the first 19 months of its life are summarized. Detailed results from the several investigations of sheet materials for wings and fuselage made under the Committee cognizance are presented. Committee recommendations for further research are outlined. Author

19 MATERIALS, NON-METALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-15891 Naval Ordnance Test Station, China Lake, Calif.
THERMAL STUDIES OF REINFORCED-PLASTIC MATERIALS. PART I. DIFFUSIVITY OF FIVE REINFORCED-PLASTIC HEAT BARRIERS
W. E. Donaldson and T. T. Castonguay Feb. 1963 18 p 7 refs
(NOTS-TP-2936; NAVWEPS-7918, Pt. I)

This report discusses a study of the thermal properties of reinforced-plastic laminates at high temperatures. Thermal-diffusivity data are given for five different laminates, and the ablation rate in mils per second is given for 15 different laminates. Author

N63-16048 Houdry Process and Chemical Co., Linwood, Pa.
AN INVESTIGATION OF PHYSICAL PARAMETERS OF NON-ELECTRICALLY CONDUCTING FINE PARTICULATES [Final Report, Mar. 1961-Sept. 1962]
D. W. Koester, E. B. Cornelius, and J. J. Donovan Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 50 p 8 refs
(Contract AF 33(616)-8032)
(ASD-TDR-62-843)

The objective of this research is to find one or more measurable properties of active ceramic powders which can be related to sinterability. Samples of active magnesia were prepared by calcination of basic carbonate at 400° C to 900° C and tested for activity in a closed system. The activity measurements, oxygen exchange, and initial specific adsorption (of CO_2), indicate that the bulk structure as well as the surface of such materials is extremely active. Data from decomposition experiments and CO_2 adsorption studies are discussed. These results emphasize the difficulties involved in preparing uniform, large-scale lots of activated powders, and the care required in their handling to avoid inadvertent contamination by absorption of atmospheric constituents (H_2O and CO_2). Author

N63-16053 Martin Co., Baltimore, Md.
THE APPLICATION OF RESIN-IMPREGNATED POROUS CERAMICS TO RE-ENTRY VEHICLE HEAT SHIELDS
Eric L. Strauss *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 7-27 11 refs (See N63-16051 13-13)

A resin-impregnated ceramic heat shield affords distinct advantages over metal radiative or ablative shields. It can sustain appreciably higher surface temperatures than a refractory metal or a superalloy shield and, in contrast to ablators, it retains its original aerodynamic contour if the surface temperatures generated during reentry do not exceed the melting or decomposition temperature of the ceramic. For the specific porous ceramics investigated, the permissible surface temperatures range from 3300° to 4000° F. Resin-impregnated porous ceramics have been tested in an oxyacetylene-torch facility to determine interior and backwall temperature-rise rates and heat flow through the back wall of the ceramic sample. Thermal properties such as conductivity, specific heat, and thermal expansion have been measured. The influence of the base ceramic and of the resin impregnant on the heat-transfer characteristics of resin-impregnated porous ceramics has been explored. Manufacturing techniques for the construction of a resin-impregnated porous ceramic heat shield have been investigated and a 15½-in.-diam. spherical nose cap has been constructed. Author

N63-16249 Rock Island Arsenal Lab., Ill.
COMPRESSION SET OF ELASTOMERS AT ELEVATED TEMPERATURES Technical Report
E. W. Bergstrom Mar. 14, 1963 25 p 10 refs
(RIA-63-798) OTS: $0.75

Compression set tests were carried out on heat-resistant rubber vulcanizates for periods as long as twenty-eight days at temperatures up to 500° F. It was found that some silicone rubbers did not have set values at elevated temperatures as low as might be expected from their excellent resistance to heat aging. Cure time was found to have a significant effect on the set of isobutylene-isoprene vulcanizates. Increased cure time resulted in lower set, even though the original cure time may have been optimum for other properties. Certain metal-oxide additives significantly lowered the set of some silicones. No one additive was found, however, which lowered the set of all four types of silicones—namely, dimethyl, methyl vinyl, fluoro and high strength. Additives which had been found previously to improve the heat resistance of silicones proved to be ineffective in lowering set. Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-15815 Remington Rand Univac. Div. Sperry Rand Corp., St. Paul, Minn.
EQUIPMENT MODIFICATIONS AND FEASIBILITY DEMONSTRATION FOR IMPROVEMENT OF THE PHASE I UNIVAC® ATC DATA-PROCESSING SYSTEM Final Engineering Report
Sept. 1962 18 p
(Contract FAA/BRD-153)

The tasks are divided into four major problem areas: (1) real-time clock function, (2) data recovery, (3) data voiding by character and field, and (4) FAA system manual. The proposed design on the real-time clock was not feasible. It was found that the only practical means for generating time was to derive a pulse from a one-revolution-per-minute motor. A data register is used to provide storage and counting ability to convert the one-per-minute pulses into computer-code time. It is recommended that data recovery be accomplished by extracting data directly from the general storage drums. This would avoid duplicate printout of flight strips and programing problems with the implementation of CUE. Data voiding by character and by field is used to eliminate the time-consuming and error-prone backspacing procedure. The FAA system manual enables technical personnel to understand the system and to provide continuing personnel with a more thorough understanding of the complete system. Author

N63-15821 System Development Corp., Santa Monica, Calif.
SOME QUEUING PROBLEMS WITH BALKING AND RENEGING—1
C. J. Ancker, Jr., And A. V. Gafarian Sept. 14, 1962 26 p 9 refs
(SP-372/001/01)

Balking (refusing to join the queue) and reneging (leaving the queue after entering) are considered. The model assumes: (1) Customers arrive from a single infinite source in a Poisson stream. (2) Arriving customers balk with probability $\frac{n}{N}$, where n is the number in system, and N is the maximum number allowed in the system. (3) Joining customers renege if service does not begin by a certain time which is a random variable with negative exponential distribution. (4) A single-service facility operates on a first-come, first-served basis with negative exponential service time distribution. For the steady state, the following are obtained: the state probabilities; mean number in queque and system; the probability of R or more in system; the probabilities of balking, waiting, reneging, and acquiring service; the customer loss rate; the distribution and mean value of time in queque for customers who acquire service; and the corresponding results for those who renege. All of these results are also obtained for a pure balking system (no reneging) by setting the reneging parameter equal to zero. Author

N63-15824 Midwest Research Inst., Kansas City, Mo.
ON THE APPROXIMATE SOLUTION OF INTEGRAL EQUATIONS OF THE CONVOLUTION TYPE [Final Report, Jan. 1, 1961-Dec. 31, 1961]
Yudell L. Luke Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 29 p 11 refs
(Contract AF 33(616)-7062)
(ARL 63-33)

Approximations to an inverse Laplace transform when the transform, which involves the exponential integral, is approximated by rational functions are studied. The approximate solution is a sum of exponential functions, and numerics are presented to show the efficiency of the technique. Author

N63-15840 Carnegie Inst. of Tech., Pittsburgh, Pa.
A BAYESIAN PROCEDURE FOR DETECTION OF SLIPPAGE Technical Report No. 8
F. B. Smith, Jr. Feb. 1963 123 p 13 refs
(Contract DA-36-061-ORD-447)
(CIT-ORD-16-TR8; AROD-1280-9)

A procedure is derived for deciding, on the basis of a sample, whether all normal populations in a given family have the same mean, or, as an alternative, that all but one of the populations have a common mean. Bayes solutions are found for the multiple-decision problem in which the exceptional population must be identified if the alternative decision is made, and for the two-decision problem where it need not be. The method is applied to a typical slippage problem, that is, where the mean of an unspecified distribution might change in either direction by a fixed, known amount. There is extensive discussion of the configuration in the sample space of the regions where the various decisions are appropriate. In each problem, the Bayes decision procedure is explicitly described. Special attention is given the case where the sample can be drawn from only a single population. Author

N63-15863 Lockheed Propulsion Co., Redlands, Calif.
STRUCTURAL INTEGRITY OF PROPELLANT GRAINS. COMPUTER OUTPUT FROM CURVE FIT STUDIES Special Report
David A. Johnson July 13, 1962 85 p
(Contract DA-04-495-ORD-3260)
(LPC-556-M-1)

The computer output is presented for the checkout of the integrated program for viscoelastic characterization from ramp strain-stress relaxation data and for the master relaxation curve from shifted constant-rate data. These data are being used for studying the structural integrity of propellant grains. R.C.M.

N63-15908 System Development Corp., Santa Monica, Calif.
QUEING WITH RENEGING AND MULTIPLE HETEROGENEOUS SERVERS
C. J. Ancker, Jr., And A. V. Gafarian Jan. 21, 1963 36 p 8 refs
Presented at the 19th Natl. Meeting of the Operations Research Soc. of America, Chicago, May 1961
(SP-372/000/01)

A Poisson stream of items arrives at a multiple, parallel serving facility consisting of s heterogeneous servers. The service time–density functions are all negative exponential and may all have different means. An arrival balks (refuses to enter) if the queue size is equal to N. If the queue size is less than N, the arrival enters the queue and is served on a first-come first-served basis unless it reneges (leaves the queue). Each entering item has a definite length of time it will wait in queue before reneging. This time is a random variable with negative exponential density function. If on arrival more than one server is free, the server to be used is chosen at random. The results obtained are for steady state and include (1) state probabilities; (2) the probability of j or more in system, $j = s, s + 1, \ldots, s + N$; (3) mean number in queue and system and mean number of busy servers; (4) probability that an arrival acquires service; (5) mean rate of loss due to balking and reneging; and (6) density functions and mean values of waiting times in queue for those who are served, those who renege, and all who enter. Certain important special cases are derived from the preceding, namely: (1) unbounded queues, (2) homogeneous servers, (3) no reneging, (4) no reneging and unbounded queues, and (5) single server. Finally, a comparison is made of a heterogeneous system with an equivalent homogeneous system. Author

N63-15909 Wisconsin U., Madison
A NECESSARY CONDITION FOR WYE-DELTA TRANSFORMATION Technical Summary Report
Alfred Lehman Mar. 1963 27 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-383)

Let the binary operations $\cup$ and $\cap$ denote the arithmetic operations of addition ($a \cup b = a + b$) and reciprocal addition ($a \cap b = ab/(a + b)$), that is, $\cup$ and $\cap$ are the series and parallel combination rules for resistor networks. It is easy to verify that the identify

(1) $(a \cup b \cup c) \cap ((a \cap b) \cup (a \cap c) \cup (b \cap c)) = (a \cap b \cap c) \cup ((a \cup b) \cap (a \cup c) \cap (b \cup c))$

holds. Furthermore, if the binary operation $\cdot$ denotes arithmetic multiplication then the identity

(2) $(a \cup b) \cdot (a \cap b) = a \cdot b$

holds. Now suppose only that $\cup$ and $\cap$ are associative commutative binary operations on an abstract set S and that there exists a commutative group R, $\cdot$ such that S is a subset of R and (2) holds on S. If in an abstract network theory $\cup$ and $\cap$ are the series and parallel combination rules and if wye–delta transformations are valid in this theory then it is shown that (1) must hold. Wye–delta transformations are valid for resistor networks but need not exist in resistor–inductor–capacitor (RLC) networks. Thus, in the presence of (2), identity (1) is a necessary but not sufficient condition for wye–delta transformation. Author

N63-15910 Wisconsin U., Madison
POWER SERIES WHOSE PARTIAL SUMS HAVE FEW ZEROS IN AN ANGLE Technical Summary Report
J. Korevaar and T. L. Mc Coy Apr. 1963 24 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-387)

Let $\sum a_n z^n$ be a power series different from a polynomial, $s_n(z)$ its partial sum of order n. Let $\nu_n(\delta)$ denote the minimum of

the number of zeros of s_n in any angle of opening δ and vertex O. In the present paper, it is assumed that $\nu_n(\delta) \leq An^{\alpha}$, n = 1, 2, ... for some $\delta > 0$ and $0 \leq \alpha < 1$. A harmonic measure technique is used to estimate the growth of the entire function in this case. Taking $A \geq 1$ when $\alpha = 0$, it is shown that $a_n = O\{\exp(-\epsilon n^{2-\alpha})\}$, with $\epsilon \geq \Omega A$ and $\log_{10}\Omega = 10^{100/\delta}$. Apart from the value of ϵ, this estimate for a_n is the best possible. The proof shows also that if $a_n \neq 0$ and $n \leq n_0$, there is a coefficient $a_{n-p} \neq 0$ with $p < \Omega An^{\alpha}$. Thus in the case of a zero free angle, the power series can have no unbounded gaps, and $a_n = O\{\exp(-\epsilon n^2)\}$. Author

N63-15939 Wisconsin U., Madison

TIED-DOUBLE-CHANGE-OVER DESIGNS Technical Summary Report

W. T. Federer and G. F. Atkinson Apr. 1963 29 p 18 refs

(Contract DA-11-022-ORD-2059)

(MRC-391)

The construction and analysis for a class of experimental designs denoted as tied-double-change-over designs are presented. These designs are useful for situations wherein the treatments are applied in sequence to an experimental unit and where the effect of a treatment persists for one period after the period in which the treatment was applied; they allow estimation of direct and residual treatment effects. Tied-double-change-over designs are constructed utilizing one, two, ..., t − 1 orthogonal latin squares for t treatments. Although the analysis is for r rows and for c columns in general, particular attention is given to the case where r = tq + 1 rows and c = ts columns for sq = k(t − 1), for k a positive integer; explicit solutions are obtained for the situations where the first period results are omitted from the analysis and where the first period results are included. A numerical example is used to illustrate the application of the results to experimental data. Author

N63-15956 Little (Arthur D.), Inc., Cambridge, Mass.

ADAPTIVE MODIFICATIONS OF LINEAR ASSOCIATIVE RETRIEVAL MAPPINGS

Stefan Peters Apr. 30, 1963 27 p

(Working Memo. ACORN-23)

A method is proposed by which a linear associative retrieval mapping can be improved by a stepwise process which utilizes any acquired knowledge of what would have been a better response to a test question than the response actually made by the mapping. Using this process, the value assigned by the retrieval mapping to any individual document in response to an inquiry must lie between −1 and +1. Since these values are thus bounded, the nonnegative restriction on retrieval mapping is eliminated. This not only simplifies the algebraic treatment, but offers the advantageous possibility of excluding certain documents as irrelevant by assigning a large negative value to certain index terms in an inquiry. The formulation and mathematical derivation of this adaptive modification process is included. M.P.G.

N63-15960 Lockheed Missiles and Space Co., Sunnyvale, Calif.

DIFFRACTION PATTERN ANALYSIS OF A RECTANGULAR APERTURE IN THE PRESENCE OF ABERRATIONS. PART I: DERIVATION OF A GENERAL SOLUTION. COMMUNICATIONS Technical Report

Hermann P. Greinel Feb. 1963 45 p 28 refs

(LMSC-6-90-62-116)

This paper discusses a general solution of the diffraction integral for a rectangular aperture considered in scanning procedures of diffraction patterns. It is shown that in the presence of aberrations, the integrand in Fresnel–Kirchhoff's diffraction formula can be expanded into a series. By this expansion, the two-dimensional diffraction integral is converted into a summation, the single terms of which divide into products of two functions where only one-dimensional integrations over products of Legendre polynomials are to be performed. In these integrations, use is made of the orthogonality property of Legendre's polynomials. Particular solutions are obtained concerning the two-dimensional diffraction pattern intensity distribution in the Gaussian image plane for an aberrant optical system and the three-dimensional intensity distribution near the focus of an aberration-free optical system. Author

N63-15972 New York U. Courant Inst. of Mathematical Sciences, N.Y.

ON THE EIGENVALUE PROBLEM Tu − λSu = 0 WITH UNBOUNDED AND NONSYMMETRIC OPERATORS T AND S

W. V. Petryshyn Jan. 15, 1963 90 p 38 refs

(Contract AT(30-1)-1480)

(NYO-10425)

An investigation is made of a general eigenvalue problem (i) Tu − λSu = 0, where T and S are some linear (in general unbounded and nonself-adjoint) operators in a complex or real Hilbert space from the point of view of the existence of eigenvalues and eigenvectors of (i) and their approximate calculation. Thus, after studying the properties of a certain class of K-positive definite and K-real operators, these properties are used to investigate the problem of existence of eigenvalues and eigenvectors of (i) and their properties under various conditions on T and S. The applicability and the unifying property of the generalized method of moments for the approximate solution of (i) are proved and a fairly general iterative method for the approximate solution of (i) which does not require the preliminary reduction of (i) to an equivalent problem with bounded operators is presented. The study allows a formulation of eigenvalue problems and solves them approximately for the case when T and S are nonsymmetric differential operators of an odd or even order. Author

N63-16151 Iowa State U. of Science and Tech., Ames

NORMAL ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KINDS

B. C. Carlson [1961] 27 p 8 refs Submitted for Publication

(NASA Grant NsG-293; Contract Nonr-220(31))

OTS: $2.60 ph, $1.01 mf

This paper describes a choice of normal elliptic integrals which appear to be very well suited for use in integral tables as well as for numerical work. The associated transformation formulas are simple, and the hypergeometric character of the elliptic integrals is emphasized. After a brief review of the hypergeometric R function, special cases of this function are chosen to be the complete integrals $R_K(z_1, z_2)$ and $R_E(z_1, z_2)$ and the incomplete integrals $R_F(z_1, z_2, z_3)$ and $R_G(z_1, z_2, z_3)$. All four functions are homogeneous and symmetric in their arguments, and the symmetry is shown to be the counterpart of the linear transformations of Legendre's integrals. The quadratic Landen and Gauss transformations take a unified form, which are derived as a special case of a new quadratic transformation of the R function. A type of practical problem is also considered for which the present choice of normal integrals offers a special advantage, i.e., geometrical and physical properties of ellipses and ellipsoids (for example, the surface area of an ellipsoid) can be represented without obscuring their symmetry in the semiaxes. Two definite integrals that are useful in this connection are evaluated in terms of the R function. I.v.L.

N63-16276 Air Force Special Weapons Center, Kirtland AFB, N. Mex.

CONSIDERATIONS OF ROOT SENSITIVITY IN THE TIME DOMAIN

Richard Marvin Joppa (Ph. D. Thesis–Illinois U.) Jan. 1963 82 p 37 refs

(AFSWC-TDR-62-123)

In this report, root sensitivity, in the form: $S^{p}_{(x)} = \frac{dp}{dx}$ is translated into the time domain by the expression of the root p (normally utilized as a complex domain quantity) as a function of system

parameter x: $p(x + \Delta x) - p(x) = S_{(x)} \Delta x$. Several quantities in the time-domain system response are functions of the root p, hence are also found to be functions of the variable x. Certain quantities in the time domain are found to be direct functions of the pole or zero sensitivity. Many other quantities are derivable. Various illustrations are presented, showing root sensitivity applications in the domain. These include the time-domain effects of radiation on β of a transistor, sensitivity reduction in a phase-locked loop, and change of airframe pitch-mode response with Mach number and altitude. Author

N63-16304 Service Bureau Corp. Application Development Dept., San Jose, Calif.
THE DISCRIMINATION BETWEEN TWO WEIBULL PROCESSES
A.S. Qureishi Sept. 14, 1962 68 p 24 refs
(Partially Supported by AFOSR and AF Development Command)
Tech. Report No. 304)

Given two production processes, the units from which fail in accordance with the Weibull distribution, the problem of selecting the particular process with the larger value of the scale parameter *b* in the Weibull distribution is considered. Three techniques are considered, and three procedures are constructed to show their advantages. An alternative sequential procedure has also been proposed and shown to be valuable in some situations. Author

N63-16318 Midwest Research Inst., Kansas City, Mo.
RATIONAL APPROXIMATIONS FOR THE INCOMPLETE GAMMA FUNCTION Summary Report, July 31, 1961–July 31, 1962
Yudell L. Luke [1962] 67 p 6 refs
(Contract Nonr-2638(00)(X))

Rational approximations are given for the incomplete gamma function that are based on descending asymptotic expansion of the function. A uniform asymptotic estimate of the error in the approximation is derived for the case where the variable z is fixed and the order of the approximation n is large. This error formula was found to give realistic values even when n was small, and a series of charts are presented for determining *a priori* the required order of the approximation necessary to achieve the desired accuracy. These charts are valuable for special cases of the incomplete gamma function such as the exponential integral, sine and cosine integrals, error functions, and Fresnel integrals. A FORTRAN code that was developed for computation of the incomplete gamma function by rational approximation is included. M.P.G.

N63-16326 Midwest Research Inst. Mathematics and Physics Div., Kansas City, Mo.
ECONOMIZATION OF INTEGRALS OF TRANSCENDENTAL FUNCTIONS Technical Report
Yudell L. Luke June 1, 1962 22 p 4 refs
(Contract Nonr-2638(00)(X))

Economic representations of indefinite integrals that involve hypergeometric functions are studied. The indefinite integral H(z) is taken as an example, and the asymptotic expansion of H(z) and its economization using the τ method gives a conservative estimate of the error, whereas the double τ method gives about twice the value for the error approximation determined numerically. Therefore, the double τ method is not preferred. M.P.G.

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-15787 Chicago U., Cloud Physics Lab., Ill.
PHLOROGLUCINOL SEEDING OF UNDERCOOLED CLOUDS
Roscoe R. Braham, Jr. Apr. 1, 1963 46 p 5 refs
(NSF Grant G-22419)
(Tech. Note 26)

A series of twelve releases of phloroglucinol were made into stratus clouds at temperatures of −7° C to −17° C. Showers produced by dry-ice seeding were used to identify particular spots in the layer clouds from which the exact locations of the phloroglucinol releases could be obtained by simple navigation. Visual observations of the cloud behavior and Formvar replicas of cloud and precipitation particles provided a means for judging the effects of the phloroglucinol seeding. It is concluded that phloroglucinol will induce the formation of ice in undercooled clouds. However, in these experiments it was not nearly as effective as the dry ice in causing shower formation. Author

N63-15798 Naval Oceanographic Office, Washington, D.C.
LONG-RANGE ICE OUTLOOK EASTERN ARCTIC [1963]
Apr. 1963 23 p

Oceanographic and climatic data for the eastern Arctic were analyzed in terms of sea-ice growth during the past winter. These analyses, combined with observed ice conditions taken during the period 15 through 25 March 1963 and a comprehensive study of historical ice and climatic information, formed the basis for the 1963 Ice Outlook. Extensive evaluation of this information indicates that present ice conditions in the Labrador Sea and along the Newfoundland coast are nearly similar to those observed in 1959; the analogous year in the Thule approaches is 1956. Goose Bay and Itivdleg are expected to open later than normal, whereas Thule and Sondrestrom will open earlier than normal. Kulusuk should open near the normal dates. In terms of the 1962 ice season, it is expected that Goose Bay and Thule will open about the same time as last year, whereas Sondrestrom and Itivdleq will open slightly later than they did in 1962. Kulusuk should be open to escorted shipping about a week earlier than last year, but will not be able to receive unescorted shipping until mid-August, about 15 days later than in 1962. Author

N63-15958 Michigan U. Inst. of Science and Tech., Ann Arbor
FEASIBILITY STUDY FOR PLACEMENT OF VORTAC AT SEA Final Report
Raymond A. Yagle, George L. West, Jr., and Joseph W. Little Apr. 1963 72 p 15 refs
(Contract ARDS-499)
(Rept. 4981-7-F)

The purpose of this study was to make a sound determination on the feasibility of various structures for positioning a VORTAC at sea. The primary contractual restraints on the project were that the study should be applicable to a single facility located at Ocean Station Charlie (latitude 52° 45′ N, longitude 35° 30′ W), that costs would be minimized, and that personnel safety would be paramount. The study extended to the broad categories of operating vessels and moored platforms. The latter category was divided to include discussion of manned and unmanned craft, such as Liberty ships, submarines, seadromes, and buoys. Of major concern in keeping the study within the imposed limits were the problem of deep-water anchoring in the North Atlantic and the reliability of present VORTAC electronic systems in a continuous, infrequently maintained application. Other troublesome problems were crew comfort, reprovisioning techniques in a continual heavy-sea environment, and the structural design of the antenna complex. Recommended methods of deep-water mooring and of heavy-weather transfer operations have been discussed in detail, and suggested solutions outlined for each substantial difficulty encountered. Author

N63-16027 Emerson Electric Mfg. Co. Electronics and Avionics Div., St. Louis, Mo.

ADVANCED CONCEPTS LABORATORY RESEARCH REPORT. AIRBORNE SPECTRAL RADIANCE MEASUREMENTS OF TERRAIN AND CLOUDS

Harry D. Nelgner and John R. Thompson Apr. 9, 1962 218 p 9 refs

(Rept. 1323; RPA-6-62)

Radiation reflected by various types of terrain and clouds between 0.35 and 2.6 microns was measured from an aircraft between altitudes of 8,000 and 20,000 feet. Measurements were made in the area between the Atlantic, Pacific, Gulf of Mexico, and the Great Salt Lake, during December 1961 and January 1962, between the hours 0950 and 1540. Presented in this reported are the frequency distributions of spectral radiance measured with eight different filters. A graphical comparison of spectral radiance of each type of background is also made for each filter. Included in the appendix are a geological description of some of the terrain in the United States, a comparison of certain physiographic features of the United States and Russia, and percentage frequencies of specified cloud cover over the United States for the months of July through November. Author

N63-16041 Technische Hochschule Darmstadt. Inst. für Meteorologie (W. Germany)

SOME PROBLEMS OF ATMOSPHERIC DIFFUSION ON VERY LARGE SCALE Technical Notes No. 2 and No. 3

F. Mesinger Oct. 31, 1962 29 p 11 refs

(Contract AF 61(052)-366)

(AFCRL-63-284)

CONTENTS:

1. SOME PROBLEMS OF ATMOSPHERIC DIFFUSION ON VERY LARGE SCALE Technical Note No. 2 F. Mesinger [p 1–22] 10 refs (See N63-16041 13-21)
2. REMARKS ON THE BEHAVIOR OF COMPUTED AIR TRAJECTORIES NEAR THE BOUNDARIES OF AN OCTAGONAL AREA Technical Note No. 3 F. Messinger p 23–27 1 ref (See N63-16042 13-21)

N63-16042 Technische Hochschule Darmstadt. Inst. für Meteorologie (W. Germany)

REMARKS ON THE BEHAVIOR OF COMPUTED AIR TRAJECTORIES NEAR THE BOUNDARIES OF AN OCTAGONAL AREA Technical Note No. 3

F. Mesinger *In its* Some Problems of Atmospheric Diffusion on on Very Large Scale Oct. 31, 1962 p 23–27 1 ref (See N63-16041 13-21)

(Contract AF 61(052)-366)

The results of an investigation of atmospheric macroturbulence in which air trajectories were computed over a period of eight days are given. Trajectories were computed by integrating the primitive equations for the homogeneous atmosphere and by use of the continuity equation. The equations were solved with the aid of an IBM 704 computer. It was found that the end points of trajectories tended to accumulate in the corners of the computation area. This accumulation and depletion is likely to be accompanied by a corresponding mass accumulation and depletion. D.E.R.

N63-16133 Cologne U. Inst. of Geophysics and Meteorology (W. Germany)

RESEARCH ON THE SYNOPTICAL MEASUREMENTS OF THE VERTICAL OZONE DISTRIBUTION Technical (Final) Report

H. K. Paetzold Jan. 1, 1963 48 p 10 refs

(Contract AF 61(052)-330)

(AFCRL-63-467)

Large-scale and small-scale measurements of the vertical ozone profile and its correlation to latitude, season, and weather are discussed. Author

N63-16207 Army Cold Regions Research and Engineering Lab. Hanover, N.H.

Quarterly Progress Report, Jan.-Mar. 1963 [PHYSICAL MECHANICAL PROPERTIES OF SNOW, ICE AND FROZEN GROUND]

Kenneth A. Linell, Albert Wuori, and E. F. Lobacz [1963] 7 p

Progress is reported on applied research and investigations studies of snow, ice, and frozen ground. Program aim is to improve military capabilities and systems in cold regions and to improve and develop engineering and construction criteria for cold-region application. Under the research and development program, tunneling and excavations, mechanics of ice, snow and ice removal, snow structures, development of trafficable surfaces, subsurface explorations, and foundation engineering are discussed. The arctic construction investigations cover frozen-ground engineering, foundations in permafrost, and heat transfer. Studies of construction in areas of seasonal frost are also included. NEA

N63-16242 Texas U. Electrical Engineering Research Lab. Austin

HIGH ALTITUDE MICROVARIATIONS WITHIN THE ATMOSPHERE'S RADIO REFRACTIVE-INDEX PROFILE

A. P. Deam and G. B. Walker Feb. 28, 1963 26 p 4 refs

(Contract AF 19(604)-8038)

(Rept. 6-52; AFCRL-63-71)

This report presents observations of certain microscale fluctuations in the radio index of refraction of the earth's atmosphere. The measurements are unique in that the height profile has been continuously detailed to one part in a million with a remote-operating 400-mc/s refractometer. Data are insufficient to reach any statistical conclusion, but are revealing in showing the turbulent structure within the height profile. A limited amount of data shows the excursions in index observed to 50,000 feet. Author

N63-16265 General Dynamics/Astronautics, San Diego, Calif.

AUTOMATIC DATA PROCESSING OF WEATHER SATELLITE DATA

Walter A. Marggraf Jan. 31, 1963 48 p 7 refs

(Contract AF 19(604)-8861)

(GDA63-0046; AFCRL-TDR-63-243)

The computer processes studied include ingestion of satellite pictorial data with digitization and digital pictorial display; data location, which includes rectification, automatic mosaicing, and mapping transformations; and data analysis, such as differentiation, slicing, and contouring of the data from pictorial intensity, and cloud-amount determination. Data from Tiros III, Orbit 509 frames are used to demonstrate the techniques and results of rectification, mosaicing, and cloud-cover-amount determination. Also included are examples of reduced and full-resolution digitized Tiros TV pictures. Author

N63-16266 Air Weather Service, Climatic Center, Washington, D.C.

ESTIMATED FREQUENCIES OF SPECIFIED CLOUD AMOUNTS WITHIN SPECIFIED RANGES OF ALTITUDE

Irving Solomon Apr. 1963 52 p 3 refs

(Tech. Report 167)

This study is designed to provide military planners, design engineers, and AWS personnel who support them, with estimates of the frequencies with which specified cloud amounts will be encountered within specified altitude ranges. The information is shown by isopleths on Northern Hemisphere base maps for the midseason months. Author

N63-16270 Public Health Service. Off-Site Radiological Safety Organization, Las Vegas, Nev.

PROJECT SEDAN. FINAL OFF-SITE REPORT OF THE PROJECT SEDAN EVENT, JULY 6, 1962. PLOWSHARE PROGRAM Final Report

O. R. Placak Nevada Test Site, AEC, Apr. 25, 1963 94 p
(PNE-200F) OTS: $2.00

The Project Sedan event was conducted as a part of the Plowshare Program at 1000 hours on July 6, 1962, in Area 10 of the Nevada Test Site by the Lawrence Radiation Laboratory. The nuclear cratering experiment resulted in the formation of a radioactive cloud which drifted northward on a 10° bearing for 40 miles to the vicinity of Queen City Summit, and then moved on a 20° bearing to Ely. From here, a nighttime wind shift carried the cloud eastward. The highest estimated total infinite exposure dose received at a populated location from the Project Sedan event was 945 mr at Diablo (population eight), and the second highest was 226 mr at Penoyer (population two). These are calculated infinite doses. Personal film badges worn by the residents and collected on July 9, 1962, indicate 150 to 170 mr dose at these two locations. The results of monitoring and environmental sampling efforts conducted by the U.S. Public Health Service Off-Site Radiological Safety Organization are presented. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-15916 General Precision, Inc., Tarrytown, N.Y.
STUDY OF MULTI-FUNCTION SENSORS FOR GUIDANCE SUBSYSTEMS First Quarterly Technical Note [July 1, 1962-Sept. 30, 1962]
Alan Bloch Nov. 1962 36 p
(Contract AF 33(657)-9207)

The purpose of the program is the ultimate development of multifunction sensors for space-vehicle guidance and navigation. This first report contains brief discussions of special experience in the field of image correlation. A section is devoted to the special problems associated with star field tracking. Author

N63-15924 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.
STUDIES IN THE FIELD OF APPROACH VISIBILITY MEASUREMENT AND INSTRUMENTATION Final Report
Matthew Lefkowitz, Andrew Caporaso, August F. Korte, Ernest E. Schlatter, and Richard J. Smith (Weather Bureau) Apr. 1962 150 p 17 refs

Flight tests were conducted in a comprehensive program designed to refine the approach-light contact height (ALCH) techniques developed empirically at Newark, and to confirm their more general applicability to other locations, types of aircraft, and operational conditions. Studies indicated that automatic control of runway and approach lights is feasible, and a design was developed for optimum intensity of these lights with regard to varying weather conditions. This design was based on the concepts of runway visual range (RVR) and ALCH to provide a means of immediate and practical application. Author

N63-15994 Lockheed Missiles and Space Co., Sunnyvale, Calif.
INERTIAL GUIDANCE, ITS EVOLUTION AND FUTURE POTENTIAL
J. S. Farrior *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 399-411 10 refs (See N63-15976 13-01)

The evolution of inertial guidance and its performance in ballistic missile systems, such as the V-2, Redstone, Jupiter, Pershing, Titan, and Polaris, are described. Since guidance for the injection phase of space missions is very similar to that for ballistic missiles, inertial guidance will probably be the principal injection guidance technique. Other uses include maintenance of a reference system, midcourse correction, acceleration measurement during the retrothrust phase of the lunar landing, and determination of a descent trajectory during Earth reentry. New devices promising exceptional accuracy, such as cryogenic and electrostatically supported gyroscopes, combined with miniaturized computer components will find other important uses in future guidance technology. M.P.G.

N63-16105 Stanford Research Inst., Menlo Park, Calif.
USE OF MINIMUM TIME TRACK DATA IN AIRWAYS DESIGN OF LONG RANGE AND OVER-OCEAN ROUTES Final Report
Sidney M. Serebreny, Eldon J. Wiegman, and Rex G. Hadfield Sept. 1962 126 p
(Contract FAA/BRD-420)
(AD-294393)

This study investigates the feasibility of utilizing minimum time tracks in airways design for long-range and over-ocean routes. Three routes are considered, using various altitude-airspeed combinations: New York to London (18,000 ft at 250 knots, 30,000 ft at 500 knots), San Francisco to London (30,000 ft at 500 knots, 53,000 ft at 1,720 knots), and San Francisco to Honolulu (30,000 ft at 500 knots). A total of 1,275 minimum time tracks taken from five winter seasons, 1955–1960, have been analyzed. From this data sample, the geographical range, distributions, and characteristic track configurations are delineated for each of the three routes. In addition, statistical evidence is given to show the range of flight-time savings on each of these routes accruing from the use of minimum time tracks rather than the great circle track. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-15782 Tennessee U., Knoxville
THE DEPENDENCE OF η ON LINE BREADTH OF THE SPECTRAL LINE R(4) OF HYDROGEN FLUORIDE Scientific Report No. 4
Hugo A. Hardt (M.S. Thesis) and N. M. Gailar Mar. 1963 45 p 6 refs
(Contract AF 19(604)-7981)
(AFCRL-63-262)

This report is a study of the variation with pressure of the true line shape of R(4) in the HF band. A modified Lorentzian line shape in which the exponent was found to be only a function of the distance from line center fitted the experimental points. The change in exponent from $\eta = 2$ to $\eta = 1.83$ occurs in the interval of 2 cm^{-1} to 3 cm^{-1} from line center. Author

N63-15786 Duke U., Durham, N.C.
THE SPIN WAVE SPECTRA OF YTTRIUM- AND GADOLINIUM-IRON GARNET Technical Report No. 2
A. Brooks Harris May 1, 1963 56 p 36 refs
(Contract Nonr-1811 (12))

The problem of deducing the values of the exchange integrals in yttrium- and gadolinium-iron garnet from measurements of the magnetization and the magnetic contribution to the specific heat at

low temperature is considered. For these garnets, the spinwave normal modes can be found by solving the semiclassical equations-of-motion which give rise to a set of n simultaneous linear equations, where n is the number of magnetically inequivalent ions in the unit cell. Expressions for the thermodynamic functions at low temperatures in terms of the frequencies of the normal modes are given assuming the validity of the spin-wave approximation.
Author

N63-15794 Union Carbide Corp. Parma Research Lab., Ohio
MEASUREMENTS OF THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF AN HIGHLY ANISOTROPIC ZT-TYPE GRAPHITE AT HIGH TEMPERATURES
J. N. Pike Apr. 22, 1963 31 p 7 refs
(Contract DA-30-069-ORD-2787)
(Res. Rept. C-16)

Measurements of with-grain and against-grain thermal conductivities and electrical resistivities have been made (over the temperature range 1200° K to 2800° K) of samples of a bulk density 2.15, controlled orientation, ZT-type graphite. The anisotropy in electrical resistivity $\rho_\perp/\rho_{||}$ drops smoothly from its room temperature value of 7.0 to a value of 4.5 at 2400° K and appears to level off at higher temperatures. At high temperatures, the anisotropy in thermal conductivity $K_{||}/K_\perp$ is 20 to 30 percent lower than $\rho_\perp/\rho_{||}$. At 2400° K, typical thermal conductivities are $K_{||} = 0.6$ watt cm^{-1} deg^{-1}, $K_\perp = 0.15$ watt cm^{-1} deg^{-1}. Total emissivities are also measured on the assumption that spectral emissivity at the pyrometer wavelength is 1.0, and, when conduction losses along some of the samples are properly accounted for, are found to be in reasonable agreement with the literature.
Author

N63-15810 Stanford Linear Accelerator Center, Calif.
HEAVY MESONS AND EXCITED BARYONS
D. B. Lichtenberg Mar. 1963 99 p 103 refs
(Contract AT(04-3)-400)
(SLAC-13) OTS: $2.25

A study was made of mass spectrum, quantum numbers, lifetimes, and decay modes of heavy mesons and excited baryons. Emphasis was placed on the determination of how conservation laws can be applied to obtain the quantum numbers. Application of the conservation laws leads to fewer selection rules in excited baryon decays than in heavy meson decays as the mesons usually decay into spinless particles.
J.A.J.

N63-15823 Babcock and Wilcox Co. Nuclear Development Center, Lynchburg, Va.
SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM Quarterly Technical Report No. 9, October-December 1962
[1962] 105 p 20 refs
(Contract AT(30-1)-2602)
(BAW-1266) OTS: $2.25

The major objective of this program is to study the nuclear properties of slightly enriched lattices moderated by D_2O-H_2O mixtures. Critical experiments were performed with 2.46%-enriched UO_2 fuel rods in a lattice having a nonmoderator-to-moderator volume ratio of 0.65. Moderator compositions were 85.5 and 70.0 mole % D_2O. Reported for each of the two cores are critical size, $d\rho/dh$, buckling and reflector savings, thermal disadvantage factor, and cadmium ratios of U^{235} and U^{238}. The first small lattice experiment (SLE) was completed, and the data, results, and conclusions are reported. Measurements of k^∞, thermal disadvantage factor, and cadmium ratios of U^{235} and U^{238} are reported for an epithermal lattice of 4%-enriched UO_2, at a nonmoderator-to-moderator volume ratio of 1.0, moderated by a 69.7 mole % D_2O-H_2O mixture. The data are in good agreement with similar measurements in an equivalent critical assembly; this agreement substantiates the validity of the SLE technique and method of analysis. Final modifications of the BPG code are reported. The revised version, known as BPG-2, is now ready for final calculations. Preliminary results of BPG and P1MG comparisons of four clean lattices are discussed.
Author

N63-15848 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)
LIMITS OF ERROR FOR THE ELECTRON DENSITY, SPIN DENSITY AND ATOMIC FORM FACTORS IN QUANTUM MECHANICAL CALCULATIONS
L. B. Rédei (Edinburgh U.) July 15, 1962 16 p 9 refs
(Sponsored by Swed. Natl. Sci. Res. Council and U.S. Air Force)
(Preprint 81)

Explicit formulas are given for the error at an arbitrary point in the electron density, spin density, and form factor derived from an approximate wave function. In the derivation extensive use is being made of some previous results by Kinoshita. The main treatment is preceded by a short discussion of some of the more mathematical aspects of the problem, and a simple numerical example is given.
Author

N63-15850 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)
"BOND ORBITAL" AND "MODIFIED ELECTRON-PAIR" CALCULATIONS ON THE AMMONIA MOLECULE
Atsushi Tsuchida (Tokyo U.) and Kimio Ohno Nov. 15, 1962 15 p 12 refs
(Partially sponsored by Swedish Nat. Sci. Res. Council and Aeron. Res. Lab., OAR)
(Preprint 87)

Nonempirical calculations of the electronic structure of the ammonia molecule are carried out using a "bond-orbital" and a "modified electron-pair" function. The calculated binding energy is 0.348 a.u. (76% of the experimental value) and 0.381 a.u. (83%), respectively. The best theoretical value previously known was 0.378 a.u., the result of a self-consistent LCAO calculation including limited configuration interaction. It is concluded that the "modified electron-pair" function is an adequate simple approximation, and the "frozen core" approximation employed in the calculation is satisfactory. The dipole moment is also calculated, and reasonable agreement with the experimental value is obtained.
Author

N63-15856 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Spektroskopie und Molekularstrahlantriebe, Stuttgart (W. Germany)
ROTATIONSANALYSE DER SICHTBAREN BrF-BANDEN UND DIE FORM DER POTENTIALKURVE DES O^+-TERMS [ROTATIONAL ANALYSIS OF THE VISIBLE BrF-BANDS AND THE FORM OF THE POTENTIAL CURVE OF THE O^+-TERMS]
P. H. Brodersen and L. V. C. Cudmani (U. Nac. Arg. de Tucuman) Mar. 1963 36 p 7 refs In German
(DVL-250) Available from Vereinigte Universitats- u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

The potential curve of the O^+ terms of the visible BrF- bands is constructed according to the method of Rydberg, Klein and Rees. In the case of interference, where this method fails, the course of the curve is obtained under plausible assumptions. Results are as follows: (1) The potential curves, which cross one another, can be constructed according to the Morse formula, $E = D_e(e^{2\beta\delta r} \pm 2e^{-\beta\delta r})$. This leads to the conclusion that the stable $3\pi_0$ term which dissociates according to $Br^x F$ is disturbed by the repelling $3\pi_0$ term which dissociates according to $Br F^x$. (2) A small disturbance in the 8th vibrational energy level is attributed to the component $3\pi_1$.
I.v.L.

N63-15857 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali di Frascati (Italy)

[LINEAR THEORY OF ACCELERATORS. PART II: CALCULATION OF THE DAMPING CONSTANTS OF THE HORIZONTAL OSCILLATIONS IN CIRCULAR MACHINES UNDER STRONG HEATING] TEORIA LINEARE DELLE MACCHINE ACCELERATRICI. -PARTE II: CALCOLO DELLE COSTANTI DI SMORZAMENTO DELLE OSCILLAZIONI ORIZZONTALI NELLE MACCHINE CIRCOLARI A FOCHEGGIAMENTO FORTE

G. Sacerdoti and F. Uccelli Feb. 28, 1963 12 p 4 refs In ITALIAN For Pt. II, see N63-12569 06-23

(Its Nota interna 190; LNF-63/18)

The calculations of the damping constants of betatron and synchrotron oscillations in a closed magnetic structure by means of a perturbation method are presented. The results obtained agree with those from earlier experiments. Trans. by PFE

N63-15889 California U., Berkeley. Lawrence Radiation Lab.

STUDY OF $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AT 1.25 AND 1.75 BeV/c FOR LOW-NUCLEON-MOMENTUM-TRANSFER COLLISIONS: EVIDENCE FOR PION-PION INTERACTIONS

William Brúle Johnson (Ph.D. Thesis) Feb. 27, 1963 98 p 33 refs

(Contract W-7405-eng-48)

(UCRL-10703) OTS: $2.25

The process $\pi^- p \rightarrow \pi^- \pi^+ n$ at incident pion momenta of 1.25 and 1.75 bev/c was studied. Two arrays of plastic scintillation counters were used to detect the final-state particles: the first array—15 cm thick, and 160 cm from the liquid-hydrogen target where the interaction occurred—detected both pions and neutrons in the forward π steradians; a second array of thin scintillators, placed near the hydrogen target, was used to detect pions in the remaining angular region. The energy of the neutron was determined by measuring its flight time for the liquid hydrogen target to the first array. Only neutrons from 5 to 50 mev were detected, thus limiting our study to those collisions in which the four-momentum transfer squared from the proton to the neutron was less than 6.5 μ^2 (where μ is the mass of the pion). Study of the data as a function of the "mass" of the two-pion final-state system corroborates the presence of a pion-pion resonance at a mass value of 750 mev. The width of the resonance is somewhat greater than that found in experiments dealing with other charge states. Author

N63-15918 Los Alamos Scientific Lab., N. Mex.

THE TWO-BODY t-MATRIX FOR A FREE BOUND SYSTEM PART I. APPLICATION TO NUCLEAR CHARGE EXCHANGE

James E. Young Feb. 8, 1963 124 p 40 refs

(Contract W-7405-eng-36)

(LA-2805) OTS: $2.50

Solutions for the Bethe-Goldstone equation that apply to the finite nucleus are sought. It is found that one of the constituents in this situation is in the continuum state, whereas the other is bound. The t-matrix, then, is averaged over the momenta distributions of the bound constituents in the equation $n + p \rightarrow n' + p'$. The solutions are applied to Be^9 (He^3, T) B^9 and the elementary, 2-body, t-matrix is found to be a dynamical operator. The final form of this operator has additive potential and can be classified both as to its diagonality of matrix elements and resonance structure. Then the sum of the diagonal and nondiagonal matrix elements gives the transition operator its properties of: (1) nuclear distortion and (2) physical change of state. This characterization of interaction dynamics arises out of the Brueckner theory and the H-F method. D.E.R.

N63-15953 Wisconsin U., Madison

THE USE OF SINGULAR INTEGRALS IN WAVE PROPAGATION PROBLEMS; WITH APPLICATION TO THE POINT SOURCE IN A SEMI-INFINITE ELASTIC MEDIUM Technical Summary Report

M. Papadopoulos Mar. 1963 77 p 15 refs

(Contract DA-11-022-ORD-2059)

(MRC-386)

This is an investigation of the field due to a general point source of energy in an isotropic, elastic solid with a free surface. The development of new plane-wave representations for the fundamental solutions of elastodynamics is discussed. There are two types of situation involved; the simpler type is involved in the case of a steady point source which moves steadily with any constant velocity in an elastic medium. This type involves superposition of plane waves with respect to a single parameter. The more complicated transient problem is considered in the case in which a point source is set up at a given moment, and thereafter moves at constant velocity, without change of strength. The new representation for the field of a steadily moving source is used in the calculation of fields and displacements in the presence of a free surface and in the transient source. The application of the new approach to the case of a vertical load, to a horizontal load, and to a couple of arbitrary orientations is discussed, and a discussion is given of the singularities to be expected for the general point source. Author

N63-15970 Los Alamos Scientific Lab., N. Mex.

ENERGY AND TIME DEPENDENCE OF DELAYED GAMMAS FROM FISSION

P. C. Fischer and L. B. Engle July 6, 1962 41 p 4 refs

(Contract W-7405-eng-36)

(LAMS-2642) OTS: $1.00

This report contains some results of an experiment designed to measure the energy and time dependence of the gammas emitted after effectively instantaneous neutron-induced fission of Th^{232}, U^{233}, U^{235}, U^{238}, and Pu^{239}. Seventeen-bin distributions of the absolute number of photons/fission-sec-mev, and intercomparisons and integrations over energy and time of these distributions are given. Gammas having energies between 0.12 and 6.5 mev were detected during five, short time intervals between 0.2 sec and 45 sec after fission occurred. Author

N63-16007 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

STORED ENERGY AND MAGNETIC FIELDS IN SPACE APPLICATIONS

R. J. Schwinghammer *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 685-710 10 refs (See N63-15976 13-01)

Stored-energy systems for space applications are described as well as applications of high-intensity magnetic fields. The areas covered include: Magnelok space tools, magnetic forming and punching tests, and Magnedok orbital docking concept. Possible future developments with stored energy, exploding bridgewires, and magnetic fields are discussed. R.C.M.

N63-16022 Rochester U., N.Y.

REPRESENTATION OF PARAFERMI RINGS

C. Ryan (Dublin Inst. for Advanced Studies) and E. C. G. Sudarshan Apr. 10, 1963 14 p 16 refs Submitted for Publication

(Contract AT(30-1)-875)

(NYO-10262)

Considered is the operator algebra corresponding to a system consisting of an arbitrary finite number, v, of parafermi oscillators, with a view to obtaining all irreducible representations of the operator algebra defining it. It is shown that this algebra is isomorphic to the Lie algebra of the orthogonal group, B_v, in $2v + 1$ dimensions. The known results of the representation theory of the orthogonal group are then used to find the representations of the ring of parafermi operators. In particular, it is seen that the so-called Green ansatz for a parafermi ring arises in a natural way and

that, in a certain sense, it furnishes the most general "solution" of the parafermi algebra. The case of a parafermi ring of order 2, which is the simplest nontrivial case, is considered in some detail. Author

N63-16036 California U., Berkeley. Lawrence Radiation Lab.
A STUDY OF THE π^+ IN THE REACTION $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ AT 365 AND 432 MeV
Julius Solomon (Ph. D. Thesis) Jan. 17, 1963 104 p 38 refs
(Contract W-7405-eng-48)
(UCRL-10585) OTS: $2.25

The differential distributions in energy and angle of the π^+ in the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ have been measured with a scintillation counter telescope used for π^+ detection and a magnetic spectrometer for π^+ energy determination at π^- incident energies of 365 mev and 432 mev. At each of the laboratory-system angles 20, 50, 80, and 110 deg, π^+ were detected in scintillation counters placed after the spectrometer. This system covered a major portion of the kinematically allowed π^+ energy spectrum. The values of T and $\Delta T \Delta \Omega$ for each counter after the spectrometer were determined by suspended-wire measurements. Loss in π^+ detection efficiency due to the decay of the π was calculated. The e^+ contamination in the π^+ telescope was calculated and found to agree with a measurement made at 20 deg. Author

N63-16049 Naval Civil Engineering Lab., Port Hueneme, Calif.
ATTENUATION OF GAMMA RADIATION IN A TWO-LEGGED 11-INCH RECTANGULAR DUCT
D. W. Green May 2, 1962 52 p 6 refs
(Tech. Rept. R-195; Y-FO11-05-329)

Results are presented of experiments carried out with an 11- × 11-inch duct in concrete with one right-angle bend, using Co^{60} as a gamma-ray source. Experiments cover the effects of moving the source and detector off the centerline position, of replacing the inside concrete corner lip with one of lead, and of removing various scattering areas in the corner. Measured values of attenuation factors for the corner and second leg are compared with calculated values, using the LeDoux-Chilton analysis. The comparisons suggest that the analysis provides an adequate treatment of the single-scatter effect in the duct. Multiple-scatter effects, however, which are not taken into account by the analysis, apparently are responsible for approximately half of the radiation reaching the detector. An empirical expression is obtained which adequately represents most of the experimental results of duct measurements available at the present time. Author

N63-16079 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ESTIMATION OF NOISE LEVELS AT THE SURFACE OF A ROCKET-POWERED VEHICLE
P. A. Franken and F. M. Wiener *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 27–31 5 refs This Paper was not presented at Symp. (See N63-16076 13-33)

Estimation procedures, based on measurements of noise on several large rocket-powered systems are presented; they are given in a generalized form that permits extrapolation to large systems. The estimation procedure involves determining the total system thrust in pounds and the effective nozzle diameter in inches, obtaining the octave band sound-pressure-level estimate for typical thrust conditions and plotting curves in terms of frequency, using the appropriate value of the effective nozzle diameter, determining the typical thrust, calculating the quantity, and adding the quantity levels. For deflector configurations in which the spacing between the rocket exhaust nozzle and the impingement point on the deflector exceeds about three times the effective nozzle diameter, the appropriate level correction in each band is made. The level estimates obtained by this procedure represent the maximum octave-band sound-pressure level to be expected, since the levels in the vicinity of the vehicle generally decrease after takeoff. Shielding effects, if present, will reduce the maximum level below the estimates obtained by this procedure. As additional data become available on larger rocket-powered systems, it is expected that this procedure will be revised to provide improved estimates for planning purposes. N.E.A.

N63-16125 Oak Ridge National Lab., Tenn.
MONTE CARLO CALCULATIONS ON INTRANUCLEAR CASCADES
H. W. Bertini (Ph. D. Thesis–Tenn. U.) May 16, 1963 220 p 80 refs
(Contract W-7405-eng-26)
(ORNL-3383) OTS: $3.00

Calculations were performed, using the basic assumptions of the Serber model, for incident π^+, π^-, neutrons, and protons on nuclei from lithium to uranium. The energy range of the incident particles varied from about 50 to 350 mev, i.e., the energy region in which pion production is not likely. Free particle cross sections were used in determining the collisions within the nucleus and statistical sampling techniques were used throughout. Results indicate that the calculations can be used to predict most of the cascade data for incident nucleons on complex nuclei but only the gross features of the data are predictable for incident pions on nuclei. The effects of several nuclear configurations on the results of the calculations were investigated in some of the areas where discrepancies exist between the experimental results and those of the calculation. These configurations consist of uniform and non-uniform nucleon density distributions in spherically symmetric nuclei of various radii. Results indicate that the greatest effect is due to the nuclear dimensions rather than the nucleon density distribution within the nucleus for a given nucleon volume. B.J.C.

N63-16132 Israel Inst. of Tech., Haifa
THE STRENGTHS OF ABSORPTION LINES IN THE 2-0 BAND OF CARBON MONOXIDE Technical (Scientific) Note No. 4
U. P. Oppenheim and Hanna Goldring (Weizmann Inst. of Sci., Rehovoth) Dec. 1962 6 p 10 refs
(Contract AF 61(052)-388)
(AFCRL-63-283)

The strengths of absorption lines in the 2-0 band of CO at 300° K have been determined; the band strength was found to be 1.51 cm^{-2}. The line strengths obtained are lower than those given by H. J. Kostkowski and A. M. Bass, whose measurements correspond to a band strength of 1.77 cm^{-2} atm^{-1}. However, the band strength 1.5 cm^{-2} atm^{-1}, given by W. S. Benedict, is in good agreement with the present value. On the other hand, S. S. Penner, by direct determination, obtained a band strength of 1.64 cm^{-2} atm^{-1}. B.J.C.

N63-16168 Army Missile Command. Propulsion Lab., Redstone Arsenal, Ala.
EMPIRICAL CORRECTIONS FOR VARIABLE ABSORPTION OF SOFT X-RAYS BY MYLAR
Bernard J. Alley and James H. Higgins Mar. 1, 1963 16 p
(RK-TR-63-7)

The characteristic X-rays of many light elements are strongly attenuated by 0.00025-inch mylar. An empirical method was developed to correct for the effects of variable 0.00025-inch-mylar thickness on the analyses of these light elements. The empirical method described has been used extensively for the past two years, and results have been excellent. Author

N63-16170 Oak Ridge National Lab., Tenn.
RECURSION RELATIONS AND SIMPLIFIED EXPRESSIONS FOR THE 6-j SYMBOLS
C. D. Zerby May 16, 1963 10 p 5 refs
(Contract W-7405-eng-26)
(ORNL-3440) OTS: $0.50

It is shown that the 144 symmetry properties of the 6-j symbols which were discovered by Regge can be displayed with a 4 x 4 array which is invariant to the ordering of three of the rows and all columns. The elements of the array are linear combinations of the quantum numbers. In addition, it is shown that a large set of three-term recursion relations exist. The recursion relations are used to deduce simplified expressions for the 6-j symbols in special cases. Author

N63-16178 Weizmann Inst. of Science, Rehovoth (Israel)
RESEARCH ON APPLICATION OF NUCLEAR SHELL MODEL TO CALCULATION OF ENERGIES OF GROUND STATES AND EXCITED STATES OF NUCLEI. Final Report, Nov. 1, 1961-Oct. 31, 1962
Amos de-Shalit Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Mar. 1963 7 p refs
(Contract AF-AEOR-62-56)
(ARL 63-61)

This report describes work done on analysis of a certain mode of excitation of odd-A nuclei. This mode, the so-called "Core Excitation," starts from the assumption that the even–even core of an odd-A nucleus should be treated separately from its odd particle. The resulting spectrum is then a superposition of the spectra of an even-even core and a single particle moving in a central potential. The motivation for this approach to the nucleus lies in the observation that even–even nuclei show considerably more "stable" regularities than the odd–even ones. In addition, one may expect that the pairing of nucleons will lead to a superconducting type of wave function for the even–even core with the odd particle hardly having any effect. The core excitation model predicts, in general, energies and spins of excited states, moments, and transition probabilities. Strictly speaking, it claims to establish only relations between moments and transitions, but other relations can be predicted. N.E.A.

N63-16179 Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, APRIL 1963
Albert V. Crewe May 15, 1963 85 p 27 refs
(Contract W-31-109-eng-38)
(ANL-6717)

Progress in both the specific reactor projects and the general engineering research and development programs is described. The report covers: (1) boiling water reactors, (2) liquid-metal-cooled reactors, (3) general reactor technology, (4) plutonium recycle program, (5) advanced systems research and development, and (6) nuclear safety. N.E.A.

N63-16187 Israel Program for Scientific Translations, Inc., Jerusalem
GRAVIMETRY. (APPARATUS AND METHODS FOR MEASURING GRAVITY)
P. F. Shokin 1963 328 p 126 refs Transl. from Russian university textbook "Gravimetriya. (Pribory i metody izmereniya sily tyazhesti)."
(IPST Cat. No. 644; OTS-61-31208) OTS: $3.25

This textbook on gravimetry (apparatus and methods for measuring gravity) is intended for students specializing in the astronomical-geodetic field. The following are discussed: (1) background of history of gravimetry; (2) determination of the gravitational force by pendulum methods; (3) determination of the gravitational force by static methods; and (4) measurement of the second derivatives of the gravitational potential. N.E.A.

N63-16231 Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France)
INTERPLAY OF COMPETING RESONANCES
Bernard d'Espagnat and Fernand Michel Renard May 1963 28 p 5 refs Submitted for Publication
(Supported Partially by AFEOAR)

A possible explanation is developed for the fact that invariant mass distributions are not always observed when more than two strongly interacting particles are produced in a collision. Although such a phenomenon may simply be due to a destruction interference with the nonresonating background, it may also be due to the production of a sufficiently broad first resonance V_1 which decays very near its point of origin while the other competing resonance V_2 sets in and washes out the observable effects of V_1. The possibility of the reactions $\Theta_1 + N \rightarrow V_1$ and $\Theta_2 + N \rightarrow V_2$ in the $\Theta_1 + \Theta_2 + N$ system is examined to determine the extent to which the real behavior of the system coincides with the qualitative prediction presented. The competition phenomenon emerges as a straightforward consequence of the final state interaction, although the kinematics involved may be too complicated to permit experimental observation of this phenomenon. M.P.G.

N63-16256 Watertown Arsenal. Materials Research Lab., Mass.
AN EXPERIMENTAL DETERMINATION OF THE EFFECT OF POWDER SAMPLE POROSITY ON X-RAY INTEGRATED INTENSITIES
J. J. De Marco and R. J. Weiss Jan. 1963 13 p 8 refs
(MRL-114; (Rev.))

Some measurements are presented which support a simple derivation for the effect of porosity on the integrated intensity of Bragg peaks in powders. A practical method of correcting for porosity is presented which makes use of fluorescent radiation from the sample. Author

N63-16280 Liège U. Inst. d'Astrophysique (Belgium)
PHYSICS OF PLANETS. PROCEEDINGS OF THE ELEVENTH INTERNATIONAL ASTROPHYSICAL SYMPOSIUM, LIEGE, JULY 9-12, 1962
1963 624 p refs In English and French
(Contract AF 61(052)-586)
(AFCRL-63-457)

Papers presented at the Eleventh International Astrophysical Symposium and published in this volume cover the following: internal construction of the planets, planetary surfaces and atmospheres, and special papers on the successive planets. Mercury, Venus, Mars, Jupiter, and Saturn are discussed. J.A.J.

N63-16282 California U., La Jolla
A CLASS OF ENERGY LEVELS FOR THE HEISENBERG LINEAR CHAIN. II. LEVELS NEAR THE ANTIFERROMAGNETIC GROUND STATE
Robert B. Griffiths [1962] 40 p 15 refs
(Contract Nonr-2216(II))
(Tech. Rept. -14)

The distribution of "unbound" states in the Bethe formalism for the linear chain of spin 1/2 atoms with a Heisenberg exchange interaction between nearest neighbors is investigated in the vicinity of the antiferromagnetic ground state, utilizing the spin-wave states discovered by des Cloizeaux and Pearson. An upper bound is obtained for the free energy of the antiferromagnetic chain at very low temperatures. Plausible arguments are presented to show that the "unbound" states actually make a negligible contribution to the partition function of an infinite chain, at least in the absence of a magnetic field. Author

N63-16284 Nihon U. Coll. of Science and Engineering, Tokyo (Japan)
[PLASMA, SOLID STATE, AND THEORETICAL PHYSICS] Annual Report
O. Hara et al 1962 49 p 59 refs
(Supported by the AEC)
(NUP-63-3)

Progress is reported on the release of atomic energy by controlled fusion reaction and related basic problems of physics. The research is divided into three groups working on the plasma physics, the solid state physics, and theoretical physics. N.E.A.

N63-16290 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

FORMULATION AND DIGITAL CODING OF APPROXIMATE HYDROGEN PROPERTIES FOR APPLICATION TO HEAT-TRANSFER AND FLUID-FLOW COMPUTATIONS

David P. Harry, III Washington, NASA, May 1963 73 p 17 refs (NASA TN-D-1664) OTS: $2.00

A description of FORTRAN language subroutine for computation of approximate state relations, thermodynamic properties, and transport properties of molecular hydrogen is presented over the range from melting to dissociation for pressures up to 340 atm (5000 lb/sq in. abs) with accuracy characterized by errors of "a few percent." The computation routine may be used in various British or metric units for any fixed ortho–para composition and requires about 2100 storages. Properties and relations used in heat-transfer and fluid-flow calculations may be obtained simultaneously with any two state variables, or enthalpy and either pressure or specific volume known. Author

N63-16309 General Telephone and Electronics Labs., Inc., Palo Alto, Calif.

INVESTIGATION OF THE ENERGY LEVELS OF MAGNETIC IONS IN THE COMPLEX METAL OXIDES, ESPECIALLY IN THE ORTHOFERRITES Final Report

Robert L. White Mar. 28, 1963 76 p 42 refs
(Contract AF 19(628)-387)
(AFCRL-63-103)

The allowed spin configurations in the rare-earth orthoferrites were derived and correlated with those observed. The susceptibilities and antiferromagnetic resonance modes of $YFeO_3$ were calculated. Paramagnetic resonance spectra of Fe^{3+} and Gd^{3+} in $YAlO_3$ were measured and analyzed to give Hamiltonian parameters. Evidence that the crystal fields are substantially different in the orthoaluminates from the orthoferrites were obtained from optical spectra. Large exchange splittings were observed in the optical spectrum of Yb^{3+} in $YbFeO_3$, indicating a large antisymmetric exchange. Author

N63-16315 Pennsylvania State U., University Park

PROGRESSING WAVE ANALYSIS OF BLAST WAVES IN SPHERES Technical Report No. 1

Norman Davids and Harry H. Calvit Nov. 30, 1962 56 p 16 refs
(Contract DA-36-034-ORD-3576RD)

The nonsteady motions initiated in metallic spheres by explosive blast in the spherical cavities within the spheres were studied to determine the process of symmetrical shock-wave propagation in solids. The method of progressing waves was applied to determine the radius vs. time diagram of the propagation of the wave into the material. The differential equations describing the propagation were integrated using a numerical program for a number of metals; and r, t diagrams were constructed using experimentally derived values for particle velocities and pressure variations on the inner surface. The shock zone, in which metals behave similar to gases as a result of explosion or impact, was found to have a very short duration (2 microseconds) in aluminum. After the shock zone, the increase in spherical volume could be accounted for geometrically. A similar time scale of events may take place in an impact crater, although the crater problem is further complicated by tangential mass flow. M.P.G.

N63-16320 Colorado School of Mines Research Foundation, Golden

MEASUREMENTS OF COUPLING BETWEEN COLUMNS OF EXPLOSIVE AND ARTIFICIAL ROCKS

Charles J. Haas and John S. Rinehart U.S. Naval Ordnance Test Station, China Lake, Calif., Nov. 1962 39 p
(Contract N123-(60530)23585A)
(NAVWEPS-8055; NOTS-TP-3058)

An attempt has been made to measure the coupling between an explosive and a material by using the "pellet technique." This technique gives a measure of one parameter of coupling, the momentum in a portion of the shock wave corresponding to twice the thickness of the pellet. One explosive, Detacord (a 40 grain/ft detonating fuse), was molded along the axes of cylindrical specimens of eight different materials. Pellets made from the specimen materials were placed on a flat surface inclined with the axis of the specimen so that the shock wave generated by the explosion would strike the surface at normal incidence. The movement of the pellets was photographed with a Fastax movie camera and their velocities determined. The pellet technique appears to give a good measure of the momentum in the shock wave; however, great care must be taken to assure a good contact between pellet and specimen. Author

N63-16328 Maryland U., College Park

NORMALIZATION CONDITION FOR THE BETHE-SALPETER WAVE FUNCTION AND A FORMAL SOLUTION TO THE BETHE-SALPETER EQUATION

Iwaco Sato June 1962 40 p 9 refs
(Contract AF 49(638)-24)
(*Its* Tech. Rept. 262; AFOSR-2759)

By the use of an inhomogeneous Bethe–Salpeter equation, a normalization condition for the Bethe–Salpeter wave function is obtained. This condition requires the normalization integral to be positive. A formal solution is obtained in the ladder approximation, and convergence of the normalization integral is proved by the use of this solution. This solution is also used to prove a dispersion relation for the vertex function of the compound particle, and to give an approximate solution. The positiveness of the normalization integral is proved in the nonrelativistic limit. The bound state of nucleon and antinucleon is studied in the ladder-chain approximation, and it is found that the normalization condition gives finite wave function in spite of divergency of the normalization integral. Author

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-15867 Nagoya U. Inst. of Plasma Physics (Japan)

EXPERIMENTS ON THE NEGATIVE RADIATION TEMPERATURE AT CYCLOTRON RESONANCE IN COLD PLASMA Research Report

Shigetoshi Tanaka, Kenji Mitani, and Hiroshi Kubo (Kyoto U.) Feb. 1963 31 p 22 refs
(IPPJ-6)

The anomalous microwave radiation from a plasma in a magnetic field was observed. The intensity was extremely large compared with that of blackbody radiation and amounted to the power radiated from the plasma in the thermal equilibrium equivalent to 5.5×10^6 °K in the case of Kr and 1.5×10^6 °K. This radiation occurred very sharply at the cyclotron field, the width being one order smaller than that of normal cyclotron radiation. The radiation was observed in Xe, Kr, and Ar plasmas in the pressure range of $p = 1 \times 10^{-1} \sim 5$mm Hg, but not in Ne and He plasmas at any pressure. Further, the radiation was observed when the whole tube was placed in a longitudinal magnetic field, but not when a part of

the positive column was immersed in the field. The theoretical condition for a negative temperature at the cyclotron resonance in a weakly ionized gas was investigated. A discussion is given as to whether this anomalous radiation could be interpreted as a phenomenon of the negative radiation temperature. Author

N63-15868 Nagoya U. Inst. of Plasma Physics (Japan)
AN EXAMPLE OF THE NON-ADIABATIC MOTION OF A CHARGED PARTICLE IN AN EXTERNAL MAGNETIC FIELD Research Report
Kazunari Ikuta and Tosiya Taniuti (Kobe U.) Mar. 1963 6 p
(IPPJ-8)

It is exhibited that in certain magnetic fields which vary over a distance of the order of the cyclotron radius, two particles of the same charge and with nearly equal initial momentums drift toward opposite directions. Author

N63-15871 Aerospace Corp. Physical Research Lab., El Segundo, Calif.
AC STABILIZED THETA PINCH Progress Report
Stanley L. Leonard and Mitchell H. Dazey Feb. 12, 1962 17 p 3 refs
(Contract AF 04(647)-930)
(TDR-930(2210-02)TN-1; DCAS-TDR-62-46)

Attempts to produce dynamic stabilization of the plasma column in the Physical Research Laboratory's theta-pinch experiment by means of an RF azimuthal magnetic field are described. The RF currents used were produced by the damped oscillatory discharge of high-voltage capacitors through the inductance of the plasma column. The maximum RF current (at the end of the first half-cycle) was 13,900 amperes at 2.5 megacycles. No evidence of stabilization was obtained. A pulsed 1-megawatt vacuum-tube oscillator, designed to produce an undamped RF current, is being constructed. Spectrographic investigation of the continuum intensity with wavelength, and the Stark broadening of the $D\beta$ Balmer line have yielded values for the electron temperature and the electron (ion) density. Author

N63-15921 Radio Corp. of America. RCA Labs., Princeton, N.J.
CESIUM VAPOR CATHODE STUDY Technical Note No. 3, Dec. 15, 1962 to Mar. 14, 1963
A. L. Eichenbaum, F. Norman, P. T. Smith, and H. Sobol David Sarnoff Research Center, Mar. 14, 1963 29 p 4 refs
(Contract AF 30(602)-2767)
(RADC-TDR-63-138)

The first tantalum common-emitter hollow cathode tube, CE-1, is to be tested. The cathode, designed to yield an extracted current density of 100 amp/cm^2, was heated to full operating temperature of 2250° K without mechanical or thermal difficulties. Plasma-cathode tubes using separate ion and electron emitters can be operated at lower temperatures, and an extracted current density of 32 amp/cm^2 was obtained from the aperture in a niobium electrode. In another tube, a hafnium surface was used for cesium contact ionization and a duoemitter-type plasma was successfully synthesized. The extracted current density through the aperture was 12.3 amp/cm^2. Author

N63-15935 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
ON THE QUASI-LINEAR THEORY OF PLASMA OSCILLATIONS IN AN ELECTRIC FIELD
Peter D. Noerdlinger Mar. 1963 7 p 6 refs Submitted for Publication
(NASA Grant NsG-96-60)
(EFINS-63-16) OTS: $1.10 ph, $0.80 mf

The study results of Fried, Gell-Mann, Jackson, Wyld, etc., on nonlinear plasma oscillations in an electric field are analyzed to delineate the directions for further attempts at analytical solution. It is found that the conclusion of Fried et al., the quasi-linear or random-phase approximation, fails if the space-averaged electron and ion distributions are displaced Maxwellians that are independent of time. D.E.R.

N63-15938 Wisconsin U., Madison
THE STEADY-STATE DIFFRACTION OF ELECTROMAGNETIC RADIATION BY AN OBSTACLE IN AN INHOMOGENEOUS ANISOTROPIC CONDUCTING MEDIUM Technical Summary Report
Calvin H. Wilcox Apr. 1963 26 p 8 refs
(Contract DA-11-022-ORD-2059)
(MRC-388)

This paper deals with the diffraction of time-harmonic electromagnetic radiation by perfectly conducting obstacles immersed in an inhomogeneous, anisotropic, conducting medium. A mathematical formulation of the problem is presented which is applicable to obstacles of arbitrary shape and to a very general class of media; and the existence, uniqueness, and continuous dependence on the data of the solution are demonstrated. Author

N63-16115 Radio Corp. of America. Missile and Surface Radar Div., Morrestown, N.J.
ELECTRODELESS MHD GENERATOR RESEARCH. PART I. THEORETICAL ANALYSIS [Final Report]
J. B. Fanucci et al Wright-Patterson AFB, Ohio. Directorate of Aeromechanics, Oct. 1962 216 p 19 refs
(Contract AF 33(616)-7913)
(ASD-TDR-62-411, Pt. I)

The theoretical investigation encompassed both the electrodynamic and gasdynamic aspects of the a.c. MHD generator and their relationship to each other. This report includes the following areas of investigation: generator impedance, side losses, fringing effects, channel flow, heat transfer, plasma viscosity, operating conditions, and starting transients. Parametric studies are included for several of these topics. The result of the above studies has led to the design of an experimental generator, which is described along with the experimental results. Results indicate that the addition of a ferromagnetic material external to the generator improves the power factor characteristics. Power factors up to 0.4 are possible at low frequencies. Supersonic rather than subsonic operation of the generator yields the higher power densities. Fringing effects indicate the need for shading magnetic fields analogous to d.c. generators. Heat protection of the a.c. MHD generator walls by transpiration cooling is feasible. Author

N63-16131 Paris Observatory, Meudon (France)
UNDAMPED WAVES IN A COLLISION FREE ELECTRON PLASMA Technical Note No. 3
Donald Mc Lean July 10, 1962 44 p 14 refs
(Contract AF 61(052)-432)
(AFCRL-63-259)

The bearing of the nonlinear theory of a collision-free plasma on Landau's plasma theory is discussed by using the example of an undamped wave for which the calculations can be completed exactly. The dispersion properties of small-amplitude, stable waves are discussed, based on the results of Denisse. The results of Landau are criticized by: (1) the contrary examples of Bernstein, Greene, and Kruskal, (2) the insufficient description by the Boltzmann equation of the trapped particles which determine the length and form of stable, longitudinal waves, (3) the applicability of Denisse's theory to reproduce Landau's damping term, and (4) proving that the dispersion relation derived by Landau is not a sound perturbation calculation, since it depends very critically on the zero-order distribution function. The effect of particle collisions within the framework of the theory of stable solutions is considered and the results obtained permit a new interpretation of the dispersion relation. D.E.R.

N63-16180 Princeton U. Plasma Physics Lab., N.J.

SOME NEW RESULTS ON THE QUASI-LINEAR THEORY OF PLASMA INSTABILITIES

E. Frieman, S. Bodner, and P. Rutherford. Dec. 14, 1962. 29 p. 5 refs.

(Contract AT(30-1)-1238)

(MATT-169)

The quasi-linear theory of plasma oscillations developed by Drummond and Pines, and Vedenov, Velikhov and Sagdeyev is examined in detail using the Bogoliubov–Krylov technique of nonlinear mechanics. For the particular case treated, the mode coupling terms which were neglected in earlier work are of the same order of magnitude as those kept. The asymptotic time development of the system is also discussed in detail. Author

N63-16271 Raytheon Co. Research Div., Waltham, Mass.

INVESTIGATION OF THE MICROWAVE PROPERTIES OF FERROELECTRICS Final Report, Jan. 20, 1961–Jan. 19, 1963

B. D. Silverman, R. I. Joseph, and W. M. Winter. [1963] 109 p. 73 refs.

(Contract AF 19(604)-8005)

(S-528; AFCRL-63-96)

A systematic and fundamental study has been made of the microwave properties of ferroelectric materials with the perovskite structure. The quantities singled out for investigation are nonlinear dielectric constant, microwave losses, and electrostriction. The comparison between theory and experiment is discussed. Author

N63-16283 Nihon U. Coll. of Science and Engineering, Tokyo (Japan)

GRAVITATIONAL INSTABILITY IN A PLASMA IN A MAGNETIC FIELD. I. IDEAL MAGNETOHYDRODYNAMICS

Ichiro Kawakami and Masatomo Sato. [1962] 21 p. 10 refs. Submitted for Publication

(NUP-63-1)

The instability of a plasma supported under gravity by a magnetic field is reconsidered using the magnetohydrodynamic equations of a perfectly conducting fluid. It is shown that the wave number (k) of physically important perturbations is limited to $ka \simeq 1$ by a finite thickness (a) of the plasma-vacuum boundary surface, and the instability growth rate is given by $\simeq (g/a)1/2$. There are some experimental supports for this result in the theta-pinch data. It is also pointed out how the interchange picture of the instability for a low β case will be generalized in a high β case, where β = (plasma pressure)/(magnetic pressure). Author

N63-16291 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELECTRON-HYDROGEN PHASE SHIFTS JUST BELOW THE INELASTIC THRESHOLD

Aaron Temkin. Washington, NASA, May 1963. 8 p. 9 refs.

(NASA TN-D-1720) OTS: $0.50

The singlet S-wave phase shifts for the scattering of electrons by atomic hydrogen just below the inelastic threshold (10.2 ev) are calculated by using a recently developed nonadiabatic theory. Previous calculations of Burke and Schey, based on the much more restricted close-coupling approximation, yielded a resonance characterized by the phase shift going through π radians. This result is indicative of a bound state of the compound system near the energy 9.4 ev. It is argued on the basis of a previous calculation that this resonance must be distinct from another resonance near 10.1 ev. On this basis it is concluded that this partial cross section must exhibit two resonances below threshold. Author

N63-16302 Plasmadyne Corp., Santa Ana, Calif.

STUDY OF MHD AND EHD FREE-CONVECTION ENERGY CONVERTERS [Final Report, Apr. 4, 1961–Mar. 31, 1962]

Meredith C. Gourdine et al. Wright-Patterson AFB, Ohio, Flight Accessories Lab., Apr. 1962. 119 p. 7 refs.

(Contract AF 33(616)-8007)

(ASD-TDR-62-320; FR022-8007)

A theoretical and experimental feasibility study of single and two-phase free-convection MHD and EHD energy conversion is summarized. Single-phase operation is shown to be impractical because the maximum possible efficiency of converting heat into flow kinetic energy is very low. Two-phase operation is far more efficient and definitely has possibilities for practical energy-conversion applications. Author

N63-16303 AiResearch Mfg. Co., Los Angeles, Calif.

VORTEX MAGNETOHYDRODYNAMIC GENERATOR EXPERIMENTAL TEST PROGRAM [Final Report, Aug. 1, 1961–Apr. 8, 1962]

H. G. Starck et al. Wright-Patterson AFB, Ohio, Flight Accessories Lab., June 1962. 73 p.

(Contract AF 33(616)-7808)

(ASD-TDR-62-459; SS-708-R)

A vortex-type magnetohydrodynamic generator was designed and fabricated on the basis of currently available materials, and was tested to determine the feasibility of obtaining electric power from a seeded combustion gas. The combustion gas was oxygen–hydrogen, seeded with potassium hydroxide solution. A power output of 0.15 watts was obtained from a vortex channel which was 4 inches wide with a magnetic field strength of 4000 gauss. The gas flow rate varied from 0.4 to 0.7 pounds per minute. This result compares with a theoretical output of 29 to 60 watts which was calculated by digital-computer methods. The low output was due to material failures throughout the unit and particularly of the combustion chamber and the center electrode. The study program indicated that the small vortex MHD generator has a significant potential provided that the material problems can be solved. Author

N63-16307 General Motors Corp. Allison Div., Indianapolis, Ind.

INVESTIGATION OF THE MONOCAPILLARY THERMIONIC EMITTER AS A DUAL SOURCE OF IONS AND ELECTRONS First Quarterly Technical Progress Report

D. L. Dresser and W. Laurita. Wright-Patterson AFB, Ohio, Flight Accessories Lab., Feb. 15, 1962. 166 p. 16 refs.

(Contract AF 33(616)-8299)

(EDR-2617)

The capillary emitter is a new approach to thermionic energy conversion—in this concept, cesium flows through a refractory emitter structure so that the emitter becomes a dual source of ions and electrons. To determine the fundamental performance characteristics of the capillary emitter, a theoretical and experimental study was conducted on a monocapillary configuration. This report summarizes the results of the investigation. Theoretical work was directed toward the solution of the exact equation describing the flow of cesium through a capillary; several approaches to the solution of the integro-differential flow equation are discussed. Since none of these has been successful to date, a linear pressure-drop model is used to predict capillary performance. The experimental device realized for this study was a monocapillary emitter and collector structure to measure ion and electron emissions as a function of emitter temperature, cesium temperature, and spacing. The fabrication and assembly of the test devices is described in detail since material and joining problems were experienced during these activities. Extensive test results are reported for a tantalum capillary of 0.4-mm diameter and 10-mm length, and for a molybdenum capillary of 0.4-mm diameter and 10-mm length. It is shown that the tantalum capillary emitter promises to yield comparable power densities to present-day thermionic converters at lower emitter temperatures, lower cesium temperatures, and wider spacings. Author

N63-16310 Selenia S. p. A., Rome (Italy)

MICROWAVE INVESTIGATION OF THE DIELECTRIC WAVEGUIDE PROPAGATION BY MAGNETO-IONIC DUCTS Technical Summary Report No. 2, Apr. 1, 1960–Dec. 31, 1961

A Gilardini July 1962 56 p 2 refs
(Contract AF 61(052)-145)
(AFCRL-63-81)

The work performed during the indicated two-year period is described. Theoretical work includes: completion of the basic theory for propagation along plasma columns in magnetic fields, derivation of Brillouin diagrams, and discussion of particularly significant limits and preliminary analyses of the nonuniform plasma case. Experimental work includes: measurements of basic propagation parameters (transmitted signal, wavelength, and group velocity) and of physical plasma parameters as the electron density. Author

N63-16312 RAND Corp., Santa Monica, Calif.
SIMILARITY SOLUTION FOR CYLINDRICAL MAGNETOHYDRODYNAMIC BLAST WAVES
Carl Greifinger and Julian D. Cole July 1962 42 p 5 refs
(Contract AF 49(638)-700; Proj. RAND)

A similarity solution is obtained for the flow behind a very strong (in the hydrodynamic sense), cylindrical, magnetohydrodynamic shock wave produced by the sudden release of energy along a line of infinite extent in a plasma. The plasma is assumed to be an ideal gas with infinite electrical conductivity, and to be permeated by the azimuthal magnetic field of a line current. It is shown that it is of critical importance to take into account the ambient magnetic pressure, no matter how small. It is found that, to preserve similarity, the external circuit is required to maintain a constant axial current; this result also appears in the related problem, treated by Greenspan, where the ambient plasma is nonconducting. It is shown that this boundary condition on the circuit implies an exchange of energy at $t = 0$ between the external circuit and the plasma. When this energy is taken into account, the dependence of the shock speed on the explosive energy can be obtained. This dependence is determined as a function of the ambient magnetic field, both for the present case and for Greenspan's case, and interesting differences are noted. The fraction of explosive energy which appears as mechanical energy is also calculated for the two cases, and again significant differences are found to exist. Other differences, with possible experimental consequences, are also discussed. The distribution of flow quantities in the neighborhood of the axis in the present case is found to be different from both the ordinary blast wave and Greenspan's case; the most pronounced differences are in the density distribution for large magnetic field and in the pressure distribution for any magnetic field whatever. Author

N63-16313 General Dynamics/Astronautics. Space Science Lab., San Diego, Calif.
RADIAL ELECTRON DISTRIBUTION IN WAKES OF HYPERVELOCITY PROJECTILES
A. H. Kritz Apr. 1963 31 p 27 refs
(Contract DA-04-495-ORD-3383(Z); ARPA Order 393-63; Proj. Defender
(BBE63-001)

The problem of utilizing microwave diagnostics for the purpose of studying the wakes of hypervelocity projectiles has been reviewed. The utilization of back-scatter microwave data is discussed. It is shown that if the wake ionization radius is considered to grow proportional to either the square root or cube root of distance behind the projectile, the microwave data is inconsistent with the assumption that the radial electron distribution is uniform, parabolic, J_0-type, Gaussian, or exponential. The effective ionization radius, in order that the linear charge density, inferred from the forward-scatter data, be consistent with that derived from the back-scatter data, has been determined as a function of distance behind the projectile for Gaussian, uniform, and parabolic radial distributions. By utilizing the data obtained from a series of shots at the NASA Ames Hypervelocity Ballistic Range, the effective radius for ionization is shown to decrease in the region of 50 body diameters to 200 body diameters behind the projectile. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-15792 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
STUDY OF ADSORPTION OF GASES ON SOLIDS IN THE HIGH VACUUM RANGE Scientific Report No. 3
C. M. Bliven and T. G. Polanyi Dec. 31, 1962 22 p 6 refs
(Contract AF 19(628)-331)
(TR-62-255.3; AFCRL-63-86)

An investigation of the interaction of nitrogen with a hot tungsten filament has shown that a chemical pumping effect occurs. The magnitude of this effect and its variation with temperature is discussed. Preliminary results on the study of the effect of adsorbed oxygen on the work function of molybdenum at room temperature have indicated that there are three stages in the adsorption process: during the first two stages, there is a rapid increase in the work function, whereas in the last stage there is a small increase and very slow rate of rise in work function. Author

N63-15801 AMP, Inc., Harrisburg, Pa.
BIBLIOGRAPHY ON THERMOELECTRIC EFFECTS AND AUTHOR INDEX
E. B. Chapman, comp. June 13, 1960 196 p 530 refs

N63-15802 Naval Ordnance Lab., White Oak, Md.
SOLID STATE RESEARCH OF THE APPLIED PHYSICS DEPARTMENT FOR THE YEAR 1961
D. F. Bleil et al July 16, 1962 64 p 96 refs
(NOLTR-62-125)

Emphasis has been placed upon the optical and electrical properties of the lead salt semiconductors and work on the compound SnTe. Surface transport studies of semiconductors were clarified by a reformulation of the Boltzmann equation. Magnetoelastic interactions constituted an important effort during the year. Acoustic investigations of SiO_2 were continued with reference to the Si-O-Si bond that included the relationships between specific heat and temperature dependence of the elastic moduli of SiO_2 glass. Laser mechanisms have been studied by the use of high-speed photography. A new alloy, Nitinol, revealed many unusual properties. Certain device applications of solid-state principles are reported. Author

N63-15826 Ohio State U. Research Foundation, Columbus
MEASUREMENTS OF THE OPTICAL CONSTANTS OF MAGNESIUM OXIDE AND CALCIUM TUNGSTATE SPECTRAL REGION BETWEEN 10 CM^{-1} AND 100 CM^{-1} AT 300° K and 90° K Scientific Report No. 4
Robert F. Rowntree (Ph. D. Thesis) Feb. 1963 65 p refs
(Contract AF 19(604)-4119)
(NASA Grant NsG-74-60)
(AFCRL-63-454)

Using the new Ohio State University far infrared spectrometer, incorporating an interferometric modulator, the optical constants n and κ of MgO and $CaWO_4$ were directly measured at 300° K and 90° K in the spectral region between 10 and 100 cm^{-1} (1.0 to 0.1 mm). The refractive indices n were computed from the maxima and minima of channeled spectra, while the extinction coefficients κ were computed from point-by-point transmission measurements. The measured values of the $CaWO_4$ optical constants were compared with those predicted from the dispersion parameters, calculated by A.S. Barker, Jr. from reflection measurements in the mid infrared; small corrections were made to the dispersion parameters, and an excellent fit was obtained. The data for MgO was

shown to confirm the findings of Smart, et al., and Saksena and Viswanathan that the eigenfrequency is in the region of 400 cm^{-1}, rather than 570 cm^{-1} as had been previously reported. The eigenfrequency data of Smart, together with the present dielectric constant results for MgO, were applied to the first and second Szigeti relations. The effective charge parameter s was found to be 0.60 at 300° K and 0.61 at 90° K; the ratio of the calculated compressibility to the measured compressibility was found to be 0.91 at 300 K and 0.88 at 90 K. The formulas suggested by other authors to improve the Szigeti relations were evaluated for MgO. The infrared absorption in this region was discussed in terms of the two-phonon process. Author

N63-15829 General Telephone and Electronics Labs., Inc., Bayside, N. Y.
A SOLID-STATE SELF-SCANNING DISPLAY DEVICE Final Report
M. S. Wasserman Nov. 30, 1962 47 p
(Contract AF 30(602)-2524)
(RADC-TDR-62-601; TR-62-204.18)

This report describes the second phase of an investigation of materials for use in a solid-state electroluminescent display device in which the electric field for activation of the electroluminescent layer is provided by elastic waves. These waves are propagated through a piezoelectric ceramic plate which serves as the substrate for the display. Author

N63-15832 General Telephone and Electronics Labs., Inc., Bayside, N. Y.
STUDIES OF ELECTRON TUBE MATERIALS AND THERMIONIC EMISSION PROCESSES Ninth Scientific Report, Apr. 1, 1962–June 30, 1962
John Florio and R. Wallace [1962] 31 p refs
(Contract AF 19(604)-7286)
(AFCRL-62-534; TR-62-704-104-204-205-208.19)

Progress to date is as follows: (1) The thermionic emission properties of ultrapure nickel-base oxide cathodes in the clean test diode are being investigated. (2) The sublimation from ultrapure N4 nickel-base barium oxide cathodes has been measured as a function of cathode temperature. Author

N63-15851 Michigan State U., East Lansing
ANTIFERROMAGNETIC BEHAVIOR IN SINGLE CRYSTALS Final Report, 1 Jan. 1961-31 Mar. 1963
R. D. Spence and H. Forstat [1963] 16 p 5 refs
(Contract Nonr-2587(03))

The objectives of this research were a study of the antiferromagnetic transition and the antiferromagnetic state at low temperatures. The work that has been carried out by the nuclear resonance technique and by specific heat studies is outlined. Each of these techniques has contributed information about both the antiferromagnetic state, and the antiferromagnetic transition. However, in the case of nuclear magnetic resonance, the principal contribution seems to have been in providing information about the antiferromagnetic state, whereas in the case of the specific heat work, the information provided is largely concerned with the antiferromagnetic transition. Author

N63-15875 Syracuse U., N. Y.
IMPURITY STATES ASSOCIATED WITH SUBSIDIARY ENERGY-BAND MINIMA
Harvey Kaplan [1962] 18 p 4 refs
(Partially supported by AFOSR)

Two results have been established concerning the existence of localized electronic states associated with a point impurity in a substance having a spherical energy band, $E(k) = E_0 + E_1 \times \cos k_1 + E_2 \times \cos k_2$, where $k_1 = k_2$, with a subsidiary minimum at $k = 0$. The first result is a generalization of Slater and Koster's result, that in one dimension an energy band with a subsidiary minimum has no localized states associated with this minimum if the impurity potential is of the δ-function type; i.e., it has only one matrix element between Wannier functions, a diagonal one referring to one site. We show that this result also holds for a spherical band in three dimensions. The second result is that, for the Coulomb-impurity potential screened by the static dielectric constant, and the above spherical band, there are hydrogen-like localized states built out of states near the subsidiary minimum, even when all powers of k in E(k) are taken into account in the equation for the envelope function. The deviation of the impurity potential from slow variation causes a long lifetime for decay of the localized state into conduction states of the same energy. For a typical shallow impurity state, the lifetime is $\cong 10^{-8}$ to 10^{-9} sec. Author

N63-15904 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
THE EFFECTS OF GAMMA IRRADIATION ON CERTAIN PROPERTIES OF CURRENT-CONDUCTING FILMS
O. K. Botvinkin and O. B. Vorob'yeva Mar. 28, 1962 4 p Transl. from Steklo i Keramika (Moscow), no. 1, 1962 p 4
(FTD-TT-62-414/1+4)

The influence of gamma irradiation on the electric conductivity of semiconductor films on glass was investigated. Glass samples coated with a semiconductor film of tin dioxide containing activated admixtures of antimony were subjected to 5.6×10^5 gamma rays. It was determined that gamma irradiation does not change the electrical properties of films. The experiments showed that semiconductor tin oxide films can be used for coating parts of instruments and apparatus subjected to gamma rays: the technical parameters of the film remain unchanged. N.E.A.

N63-15907 Illinois U., Urbana
THE INFLUENCE OF ELECTRON INTERACTIONS ON SOME PROPERTIES OF METALS
Seth David Silverstein (Ph. D. Thesis) Jan. 1962 168 p 38 refs
(Contract DA-11-022-ORD-1001)
(Tech. Rept. 28)

This thesis includes: (1) the consideration of a detailed extension of the Noziere–Pines momentum-transfer interpolation procedure for calculating the low-temperature specific heat and the static paramagentic spin susceptibility for the region of actual alkali metallic densities; (2) a study of the formal theory of paramagnetic response to time-dependent inhomogeneous magnetic fields; (3) a discussion of various magnetic resonance experiments from which information may be obtained concerning the nature of the response to this magnetic resonance; (4) a summary of some of the formal aspects of theory, that should prove of use to the reader who is not acquainted with the application of Green's functions to the electron gas problem; and (5) a study, from first principles, of the nature of the spectral distribution functions for an interacting thermodynamic system. I.v.L.

N63-15929 Los Alamos Scientific Lab., N. Mex.
SELF-DIFFUSION IN SINGLE-CRYSTAL TUNGSTEN AND DIFFUSION OF RHENIUM TRACER IN SINGLE-CRYSTAL TUNGSTEN
Robert L. Andelin Apr. 22, 1963 156 p 91 refs
(Contract W-7405-eng-36)
(LA-2880) OTS: $2.50

Self-diffusion in single-crystal tungsten and diffusion of rhenium tracer in single-crystal tungsten have been measured over the temperature range 2660° C to 3230° C by the direct-sectioning technique. Initial radioactive layers of tracers were produced by bombardment with 9.0-mev deuterons to approximate the boundary-condition requirements of the one-dimensional diffusion equation. The tracers were: W^{185}, Re^{183}, and Re^{184}. The data obtained were compared with the predictions of the models for the

diffusion process, and the results are consistent with a ring mechanism as the fundamental step in tungsten self-diffusion. Then, since rhenium atoms have nearly the same charge and size as tungsten atoms, it can be assumed that the rhenium tracer may diffuse through a tungsten lattice by a similar mechanism. D.E.R.

N63-16050 National Bureau of Standards. Radio Standards Lab., Boulder, Colo.
TABLES TO FACILITATE THE DETERMINATION OF THE FERRIMAGNETIC RESONANCE LINEWIDTH OF NON-METALLIC MAGNETIC MATERIALS
Constance C. Preston and William E. Case Apr. 15, 1963 37 p 2 refs
(NBS-TN-173) GPO: $0.25

A table is provided which gives values of attenuation according to the following formula, thus facilitating the determination of linewidth:

$$A = 20 \log 2 - 20 \log \left(10^{\frac{A_o - A_r}{20}} + 1\right) \text{ for } A_o - A_r = 0.41(0.01)\ 32.40.$$

Here, A_o is the cavity resonance of the empty cavity; A_r is the cavity resonance of an inserted sample under conditions of maximum absorption. I.v.L.

N63-16068 Honeywell Research Center, Hopkins, Minn.
THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM Final Report [1960-1962]
May 31, 1962 68 p 58 refs
(Contract AF 49(638)-908)
(AFOSR-2648)

The report reviews the various aspects of tellurium which have been subjected to intensive examination during 1960–1962. Work on zone purification and growth of doped and undoped single crystals is noted. Mechanical properties, plastic damage, and identification of dislocations by etch pits are briefly covered. A section on optical properties notes the discovery of optical activity in tellurium, and details the work on intrinsic optical absorption, showing how this implies a "vertical" transition at the absorption edge, which is allowed for $E \perp C$ and forbidden for $E \parallel C$. The progress made in understanding recombination processes in tellurium (both flaw processes and band-to-band processes) is discussed. A section on transport effects outlines the extensive studies made of magnetoresistance, and the recent measurements of hole mobility at low temperatures in doped and undoped crystals. Some of the expectations concerning the energy-band structure of tellurium are reviewed. Author

N63-16101 Naval Ordnance Test Station, China Lake, Calif.
TRANSMITTANCE MEASUREMENTS OF OPTICAL MATERIALS AS AFFECTED BY WEDGE ANGLE AND REFRACTIVE INDEX IN THE 2- TO 15-MICRON RANGE
K. B. La Baw, A. N. Olsen, and L. W. Nichols Apr. 1963 35 p 2 refs
(NAVWEPS-8086; NOTS-TP-3116)

Error in the measurement of transmittance can be made with samples having nonparallel faces. This has been investigated because of the extensive use of transmittance as a tool for determining properties of semitransparent materials. Specimens of fuzed quartz, arsenic trisulfide, silicon, and germanium, representing a range of refractive indices, were fabricated to provide 0-, 1-, 2-, 5-, and 10-milliradian wedges across 1-inch-diameter disks. Transmittance measurements were taken in the 2- to 15-micron range with Perkin-Elmer Models 21 and 221 spectrophotometer, and correlated with refractive index, and such as fused quartz, the error introduced even by the 10-mil wedge was negligible. However, for high-index materials, such as germanium, as much as 60% error was introduced by the 10-mil wedge. Author

N63-16106 Westinghouse Electric Corp. Air Arm Div., Baltimore, Md.
STUDY OF FAILURE MECHANISMS Final Report [July 1, 1961-Sept. 30, 1962]
S. M. Skinner and J. W. Dzmianski Griffiss AFB, N.Y., Rome Air Development Center, Dec., 1962 297 p 38 refs
(Contract AF 30(602)2558)
(RADC-TDR-63-30)

Causative mechanisms leading to failure in electronic components and materials were surveyed in order to develop an experimental methodology for measuring quantities contributing to failure. The following test results are discussed: (1) failure during manufacture and tests of military systems can be related to device complexity (number of junctions, leads, etc. of the device); (2) the electrical–frictional probe technique may be a useful nondestructive test of semiconductor materials because of its demonstrated sensitivity to compositional and structural changes; (3) repetitive tests using surface contacting techniques indicate that semiconductor surfaces age nonuniformly; (4) flexure-charge tests indicate that deterioration of semiconductor devices may result from mechanical stresses such as those encountered in fabrication of these devices; (5) transistor failure due to surface charging is reversible; (6) failures due to high-energy radiation were not detected in ferrite magnetic materials by the Mössbauer spectrum analysis technique; and (7) radiation degradation of silicon radiation detector diodes may be related to low-flying defect energy levels resulting in the anomalous capacitance effect. M.P.G.

N63-16112 Armour Research Foundation, Chicago, Ill.
ORGANIC SEMICONDUCTORS [Final Report, Mar. 15, 1959-Mar. 14, 1962]
C. Sosnovsky Washington, AFOSR, Mar. 1962 64 p 16 refs
(Contract AF 49(638)-576)
(ARF-3142-12; AFOSR-2663)

The dielectric, spectroscopic, and photoconductive properties of selected addition compounds and their donor and acceptor components were investigated. The study of dielectric properties entailed measurements of dielectric losses, dielectric constants, and dielectric resistivities on compressed powders. The data indicate that polarization effects caused by migrating charges are probably responsible for the high loss regions found at low frequencies. At higher frequencies bimodal temperature-dependent loss curves were found for some addition compounds. The spectral response of photoconduction in single crystals of two addition compounds and their components was measured as a function of field direction, applied voltage, high intensity, and time of illumination. The results show that space-charge buildup effects set up by traveling charge carriers dominate the conduction mechanism. The correlation of spectral response data with spectroscopic data was variable.
Author

N63-16113 Electro-Optical Systems, Inc., Pasadena, Calif.
ENERGY CONVERSION STUDY OF SEMICONDUCTOR ELECTRODES [Final Report, Feb. 1961-Dec. 1961]
I. R. Tannenbaum Wright-Patterson AFB, Ohio, Flight Accessories Lab., June 1962 42 p
(Contract AF 33(616)-7939)
(EOS-1640-Final; ASD-TDR-62-89)

Four electrodes, lithiated nickel oxide, zinc oxide, anthracene, and phenanthrene have been studied. Sample preparation is described; overvoltage, specific reaction-rate constants, stoichiometric number, rate-limiting steps, exchange currents, and equilibrium potentials are determined. The application of these data to fuel-cell technology is discussed. Author

N63-16172 Michigan U. Inst. of Science and Tech., Ann Arbor
EFFECT OF CHEMISORBED OXYGEN ON PHOTOVOLTAIC AND PHOTOCONDUCTIVE PROCESSES IN RUTILE
R. Keezer May 1963 11 p 7 refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Memo. 2900-400-R)

It has been found that the presence of adsorbed oxygen increases both the response and the response time for the photovoltaic effect in rutile. The model for the effect of chemisorbed oxygen on the photoconductivity has been modified to take into consideration the effect of oxygen pressure. The conductance of rutile has been measured as a function of oxygen pressure. The results agree with the modified model. The increase in photovoltaic response and response time with exposure to oxygen has been explained in terms of the barrier layer formed by chemisorbed oxygen. Author

N63-16189 Stanford Research Inst., Menlo Park, Calif.

ANALYSIS OF ROCKS AND MINERALS BY REFLECTED INFRARED RADIATION

R. J. P. Lyon and Eugene A. Burns Repr. from Econ. Geol., v. 58, 1963 p 274-284 17 refs

(NASA Contract NASr-49(04))

This paper deals with the reflected infrared analysis of several common minerals, rocks, and meteoritic materials. The optical principles involved, and the typical spectra to be obtained from quartz plates, fused silica, and glasses are briefly reviewed, and recent spectral data from minerals and rocks are examined. Similarities and differences between absorption and reflection spectra for the same materials are discussed, and some of the problems encountered in the calculations of composition (modal analysis) are indicated. Applications to nondestructive testing of polished rock surfaces (or gems) and to the calculation of ambient-temperature emissivity curves for rocks are shown. Such spectral emissivity curves are an important prerequisite for the remote mapping of the lunar and other planetary surfaces. Author

N63-16243 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)

[SUPERCONDUCTING MAGNETS] I MAGNETI SUPERCONDUTTORI

G. Pasotti, N. Sacchetti, G. Sacerdoti, and G. Sanna Apr. 23, 1963 17 p 20 refs In Italian

(*Uts* Nota interna 195; LNF-63/26)

Four solenoids made of hard superconductors (Nb-Zr) were tested. One solenoid consisted of two coaxial sections and was of bare wire containing 25% of Nb-Zr. The other three solenoids consisted of either one or two coaxial sections and were fabricated out of nylon insulated wire with the Nb-Zr content at 33%. Maximum fields for the experiment varied from 8.2 to 36.0 kilogauss. Six graphs were given showing percentage of maximum residual field against distance from the center of the coil in centimeters.

Trans. by P.F.E.

N63-16252 Pennsylvania U. Lab. for Research on the Structure of Matter, Philadelphia

AN INTERPOLATION APPROACH TO THE GREEN FUNCTION THEORY OF FERRO-MAGNETISM Technical Report No. 10

Raza A. Tahir-Kheli (Pakistan Atomic Energy Comm.) Apr. 1963 46 p 33 refs

(Contract Nonr 551(36))

The difficult problem of decoupling the Green functions of a Heisenberg ferromagnet is approached from an *ad hoc* point of view. As indicated by Wortis, the Green functions pertaining to spin problems do not obey a simple Dyson equation; the higher order Green function is proportional to the lower order Green function (the proportionality factor being the "mass operator") plus an anomalous additive term. The form of both the mass operator and the anomalous term is here evaluated by requiring agreement of the theory with rigorous results known from low-temperature and high-temperature expansions. The mass operator is found to be almost precisely that proposed by Callen on heuristic grounds. At low temperatures, the anomalous term makes a particularly significant correction to the results for spin 1/2, but becomes relatively unimportant for higher spins. Near the Curie temperature, however, the contribution of the anomalous term is important even for larger spin values. The resultant theory agrees with the Curie temperature estimates of Rushbrooke and Wood or Domb and Sykes to within about one percent. It is found that within the random phase, and the Callen approximations, the susceptibility obeys a relation of the from $X = \text{const.}\ (1\text{-}Tc/T)^{-2}$, whereas the magnetization approaches zero as $(1\text{-}T/Tc)^{1/2}$. However, when the anomalous term is taken into account consistently, the theory predicts that if the susceptibility is set to agree with Domb and Sykes result, $X = \text{const.}\ (1\text{-}Tc/T)^{-4/3}$, the magnetization below the Curie point would approach zero as $(1\text{-}T/Tc)^{1/3}$. Author

N63-16257 Oklahoma State U. Research Foundation, Stillwater

RELATION BETWEEN PHOTOCONDUCTIVITY AND CHEMISORPTION KINETICS FOR STANNIC OXIDE CRYSTALS Technical Report No. 2, May 1, 1962-Jan. 15, 1963

J. E. Hurt and E. E. Kohnke Jan. 1963 47 p 15 refs

(Contract Nonr-2595(01))

The photoconductive behavior of a number of natural and artificial crystalline specimens of stannic oxide has been investigated in various gaseous ambients at pressures ranging from 10^{-7} mm Hg to atmospheric, and at temperatures over the interval between 90° K and 355° K. Dependence of photocurrent rise and decay rates on pressure and temperature has been found to be consistent with the predictions of a model relating surface trapping of electrons and Elovich-type chemisorption. Author

N63-16305 Borg-Warner Corp., Chicago, Ill.

THEORY OF THE THERMAL CONDUCTIVITY OF METALS, ALLOYS, AND SEMICONDUCTORS [Final Report, June 1960-July 1961]

John R. Madigan Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Aug. 1962 69 p 17 refs

(Contract AF 33(616)-7374)

(ASD-TDR-62-74)

The present status of the theory of thermal conductivity in solids is such that although the processes leading to thermal resistance are understood in a qualitative manner, there is no reliable quantitative theory. To illustrate the successes and failures of the present theory, the heat conduction in a perfect linear lattice has been calculated. In a perfect crystal of reasonable size, phonon-phonon interactions are the only scattering events which determine the thermal resistance, and the transition probability vanishes for phonon-phonon scattering in a one-dimensional lattice. We have demonstrated that, to simultaneously satisfy the selection rules on the wave vectors and the energy, at least one of the wave vectors must be equal to a reciprocal lattice vector (more precisely zero in the one-dimensional case). This causes the transition probability, as calculated by first-order perturbation theory, to vanish for cubic anharmonic terms in the potential energy of the lattice. The thermal conductivity of simple alloys has been calculated by assuming that the additional scattering in the alloy is due to the mass difference of the elements comprising the alloy. This "isotope effect" has been used to calculate the thermal conductivity of Si-Ge alloys. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-15773 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HELIUM CONCENTRATIONS DOWNSTREAM OF A VENT EXHAUSTING HELIUM AT SONIC VELOCITY INTO A SUPERSONIC STREAM OF AIR AT MACH NUMBERS OF 3.51 AND 4.50
Robert L. Stallings, Jr. and Paul W. Howard Washington, NASA, May 1963 21 p 3 refs
(NASA TN-D-1787) OTS: $0.50

Concentration profiles of helium have been measured at three axial stations downstream of a helium vent exhausting at sonic velocity into a supersonic stream of air. The sampling stations were located at 7.2, 14.4, and 21.7 vent diameters downstream of the vent. The tests were conducted at free-stream Mach numbers of 3.51 and 4.50, ratios of vent static pressure to free-stream static pressure from approximately 4 to 18, and helium stagnation temperatures of approximately 550° R and 260° R. Increasing the ratio of vent pressure to free-stream pressure resulted in a general increase in the concentration profiles at all three measuring stations and a decrease in the rate of decrease with distance of the maximum measured concentration through 21.7 vent diameters downstream of the vent. Increasing the vented-gas stagnation temperature resulted in an increase in the rate of mixing of the vented gas and the ambient air. Author

N63-15820 C. A. V. Ltd., London (Gt. Brit.)
STUDY OF BURNING RATE AND NATURE OF COMBUSTION IN DIESEL ENGINES
W. T. Lyn [1962] 28 p 11 refs Presented at the Reciprocating Engine Combustion Colloq. of the Ninth Intern. Symp. on Combustion, Cornell U., Ithaca, N. Y., Aug. 26–Sept. 2, 1962

The burning rate and the nature of combustion in the diesel engine are reviewed to determine the extent to which the burning rate can be controlled by the injection rate and to obtain a basic understanding of the nature of combustion in diesel engines. Both normal operating engines and an engine model are used for the study. The factors that control the burning rate are examined. These are: the injection rate, engine speed, and combustion chamber design. All of these factors directly affect mixing. Direct injection (D.I.) engines were used in the analysis. D.E.R.

N63-15836 Arde-Portland, Inc., Paramus, N. J.
Summary Report No. 4, April 1-Sept. 30, 1962 [FEASIBILITY STUDY ON APPLICATION OF LIQUID ROCKET ENGINE COOLING TECHNIQUES TO SOLID ROCKET NOZZLES]
Philip Wachs 1962 43 p 1 ref
(Contract DA-30-069-ORD-3099)

Four test firings of uncooled nozzles were conducted to determine their heat transfer coefficients. The values obtained agreed reasonably well with predicted values, and will be used to evaluate proposed firings of lithium convection-cooled nozzles. In addition, the labyrinth seal coupling which connects the convection-cooled nozzle to the condenser piping was tested at various pressures and found satisfactory for installation in the cooled-nozzle test rig. M.P.G.

N63-15893 Rohm and Haas Co. Redstone Arsenal Research Div., Huntsville, Ala.
QUARTERLY PROGRESS REPORT ON ENGINEERING RESEARCH, SEPTEMBER 15, 1962 TO DECEMBER 15, 1962
W. H. Groetzinger III and Orville H. Loeffler Apr. 19, 1963 72 p 8 refs
(Contract DA-01-021-ORD-11878)
(p-62-27)
CONTENTS:
1. DEFORMATIONS AND STRESSES IN AXIALLY ACCELERATED CASE-BONDED SOLID PROPELLANT GRAINS OF FINITE LENGTH C. H. Parr p 1-49 1 ref (See N63-15894 13-26)
2. DEFORMATION OF VISCOELASTIC CYLINDERS OF INFINITE LENGTH AND ARBITRARY CROSS SECTION UNDER AXIAL ACCELERATION LOADS C. H. Parr p 50-66 7 refs (See N63-15895 13-26)

N63-15894 Rohm and Haas Co. Redstone Arsenal Research Div., Huntsville, Ala.
DEFORMATIONS AND STRESSES IN AXIALLY ACCELERATED CASE-BONDED SOLID PROPELLANT GRAINS OF FINITE LENGTH
Charles H. Parr *In its* Quarterly Progress Rept. on Engineering Research, Sept. 15, 1962 to Dec. 15, 1962 Apr. 19, 1963 p 1-49 1 ref (See N63-15894 13-26)

Additional calculations, using the method derived for shrinkage loads, are made for the deformations and stresses of the axial-acceleration case-bonded solid-propellant grains. Two end cases are considered: two free ends, and one free and one fixed end. Results are presented in terms of three parameters: the alpha ratio, inner-to-outer radius, the lambda ratio, length to diameter, and Poissons ratio, nu. D.E.R.

N63-15895 Rohm and Haas Co. Redstone Arsenal Research Div., Huntsville, Ala.
DEFORMATION OF VISCOELASTIC CYLINDERS OF INFINITE LENGTH AND ARBITRARY CROSS SECTION UNDER AXIAL ACCELERATION LOADS
Charles H. Parr *In its* Quarterly Progress Rept. on Engineering Research, Sept. 15, 1962 to Dec. 15, 1962 Apr. 19, 1963 p 50-66 7 refs (See N63-15893 13-26)

The equations of motion, shear formulas, satisfactory boundary conditions, and displacement formulas are derived for star-shaped and other symmetric propellant grains of infinite length whose internal perforations are not circular. The equations of motion of a viscoelastic solid were reduced to an uncoupled set by assuming that the deformations do not vary with the coordinate direction along which the acceleration is applied. These results were then applied by using conformal mapping to axially accelerated cylinders with axes of symmetry. A closed form solution was obtained for the axial displacement and evaluated for a certain set of boundary conditions and a particular geometry. D.E.R.

N63-15954 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THE YIELD OF NITRIC OXIDE FROM PREMIXED FLAMES OF HYDROGEN AND HYDROCARBONS WITH NITROUS OXIDE
Burton D. Fine and Albert Evans Washington, NASA, May 1963 22 p 14 refs Presented at the Western States Combustion Inst., San Diego, Calif., Apr. 29-30, 1963
(NASA TN-D-1736) OTS: $0.75

The yield of nitric oxide (NO) from premixed flames containing nitrous oxide (N_2O) was measured on a cooled porous-plate burner. For rich hydrogen (H_2) - N_2O flames with an inert diluent, results indicated that NO was formed by reaction of N_2O with H_2. For rich ethylene- and acetylene-N_2O flames, results suggested that NO was formed from N_2O and oxygen (O). Results for lean H_2-N_2O-diluent flames showed that O is maintained by equilibrium with O_2, the contribution of thermal decomposition of N_2O being small. Author

N63-15965 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY, 1963
Russell W. Dayton and Ronald F. Dickerson Mar. 1, 1963 88 p refs
(Contract W-7405-eng-92)
(BMI-1619 (Del.)) OTS: $2.00

Reports relating to civilian applications for nuclear energy include: (1) reactor materials and components; (2) fuel studies, (3) general fuel element development, (4) radioisotope and radiation applications, (5) development of a tracer system for in-place filter evaluation, (6) materials development and evaluation, (7) coated-particle fuel material, (8) corrosion studies of the fluoride-volatility process, (9) progress on the U.S. Atomic Energy Commission–Atomic Energy of Canada Limited Cooperative Program, (10) fission-product deposition studies, (11) irradiation of materials and components, (12) gas-cooled reactor program, (13) process development and evaluation of properties of F-48 niobium alloy, and (14) joining of regenerative cell components. I.v.L.

N63-15975 Atlantic Research Corp., Alexandria, Va.
IMPROVEMENT OF THE USEFULNESS OF PYROLYTIC GRAPHITE IN ROCKET MOTOR APPLICATIONS Second Annual Technical Summary Report [June 1, 1961 through May 31, 1962]
James D. Batchelor, Edwin F. Ford, and Eugene L. Olcott June 1962 56 p 3 refs
(Contract DA-36-034-ORD-3279-RD)

Studies of the deposition process variables were continued, with emphasis on methods of improving the microstructure of coatings formed at lower deposition temperatures. A substrate pretreatment consisting of a furane resin impregnation shows promise. Major emphasis was placed on the measurement of the erosion rate of nozzles coated with a standard (2000° C) grade of pyrolytic graphite in rocket motor firings. For propellants with flame temperatures of 5600° F and 6000° F, the erosion rate was very low. With a 6500° F propellant, erosion increased with increasing motor pressure and reached a rate near 0.5 mil/sec at about 900 psi. This result indicates the utility of pyrolytic graphite for solid-propellant rocket nozzles. Mechanical-design and stress-analysis calculations were made; based on these, the utility of segmented nozzle designs was substantiated. Author

N63-16062 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CRYOGENIC-PROPELLANT HEATING IN THE THERMAL ENVIRONMENT OF SPACE
G. R. Smolak and R. H. Knoll *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 293–331 29 refs (See N63-16051 13-13)

The heat transfer by radiation from the sun and planets to propellant tanks is discussed in detail as is the effect of using various thermal barriers to reduce propellant heating. An extensive list of equations is included to summarize the results of the analytical derivations for each particular thermal protection system. The ultimate effect of the thermal environment of space on the design of a particular vehicle is a weight penalty directly chargeable to this environment. A method of calculating and optimizing this weight penalty is included for a hypothetical Mars trip with a hydrogen–oxygen fueled chemical stage. Author

N63-16188 Rocketdyne, Canoga Park, Calif.
RESEARCH IN HYBRID COMBUSTION Final Report, 1 Dec. 1961 through 31 Jan. 1963
T. Houser May 15, 1963 48 p 8 refs
(Contract Nonr-3016(00))
(R-5179)

The instantaneous surface regression rates have been calculated as functions of time and axial distance from the radius vs. time data obtained from plexiglas combustion. Temperature measurements of the fuel behind the regressing surface have been made. Additional experiments were carried out to examine the burning rates of different fuels such as polystyrene, polyethylene, 30- and 60-% aluminum, 30-% titanium hydride, and 1/4- and 1/2-% carbon in plexiglass. The significance of the burning-rate and temperature-measurement results is discussed. Author

N63-16233 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, Ohio
INVESTIGATION OF EFFECT OF NUMBER AND WIDTH OF ANNULAR FLAME-HOLDER GUTTERS ON AFTERBURNER PERFORMANCE
James G. Henzel, Jr., and Lively Bryant Washington, NACA, June 3, 1954 27 p 4 refs
(NACA-RM-E54C30) OTS: $2.60 ph, $1.01 mf (Declassified)

An investigation was conducted in a 26-inch-diameter afterburner test rig to determine the effect of the number and width of annular flame-holder gutters on afterburner performance. Four flame-holder configurations were investigated at 1250° F over a range of fuel–air ratios from 0.03 to 0.10, and burner inlet pressures from 450 to 1300 pounds per square foot absolute. A 3-ring, 48-percent blockage flame holder had 15 to 20 percentage points higher efficiency than a 1-ring, 23-percent blockage flame holder. Gutter widths of 1.5 inches or more appeared necessary for good low-pressure performance. If nonburning total-pressure losses in excess of 2 percent are to be avoided, flame-holder blockages should not exceed 35 percent for burner inlet velocities greater than 500 feet per second. Author

N63-16234 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, Ohio
PERFORMANCE OF A SHORT COMBUSTOR AT HIGH ALTITUDES USING HYDROGEN FUEL
Joseph N. Sivo and David B. Fenn Washington, NACA, Aug. 7, 1956 21 p 2 refs
(NACA-RM-E56D24) OTS: $2.60 ph, $0.83 mf (Declassified)

Performance characteristics of a 16-inch annular-type combustor, installed in a full-scale engine using gaseous-hydrogen fuel, were obtained at simulated altitudes from 66,000 to 86,000 feet at a flight Mach number of 0.8. Combustion efficiencies of 86 percent were obtained at 86000 feet (combustor pressure, 420 lb/sq ft abs). Author

N63-16235 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, Ohio
EFFECTS OF SOME CONFIGURATION CHANGES ON AFTERBURNER COMBUSTION PERFORMANCE
Shigeo Nakanishi and Charles R. King Washington, NACA, June 12, 1957 61 p 10 refs
(NACA-RM-E57C01) OTS: $6.60 ph, $2.03 mf (Declassified)

An experimental investigation was conducted in a 25.75-inch-diameter simulated-afterburner test rig to evaluate the combustion performances of (1) a V-gutter flame holder with reduced-diameter gutterrings, (2) an inclined radial-gutter flame holder, (3) a tapered-shell afterburner, and (4) V-gutter flame holders with turbulence generators added. The investigation covered a range of afterburner fuel–air ratios; afterburner–inlet pressures, temperatures, and velocities; and afterburner lengths. All configurations operated with combustion efficiencies no higher, and pressure–loss coefficients no lower, than those of the conventional V-gutter configuration taken as reference. The inclined radial-gutter flame holder was the only configuration with lean blowout limits consistently better than those of the reference configuration. Author

N63-16236 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, Ohio
EXPERIMENTAL INVESTIGATION OF EFFECTS OF COMBUSTION-CHAMBER LENGTH AND INLET TOTAL TEMPERATURE, TOTAL PRESSURE, AND VELOCITY ON AFTERBURNER PERFORMANCE
Charles R. King Washington, NACA, June 3, 1957 79 p 14 refs
(NACA-RM-E57C07) OTS: $7.60 ph, $2.57 mf (Declassified)

The afterburner used in this investigation is typical of current high-performance V-gutter-type afterburners without internal cooling liners. The range of conditions investigated was: temperature, 1260° to 1860° R; pressure, 750 to 1800 lb/sq ft abs; velocity, 400 to 650 ft/sec; fuel–air ratio, lean blowout to higher than stoichiometric; combustion-chamber length, 30 to 66 in. The data presented determine systematically the effect of these variables on combustion efficiency (for three fuel–air ratios), combustion-chamber total-pressure-loss coefficient, lean blowout limits, and combustion instabilities. Author

N63-16253 Worcester Polytechnic Inst., Mass.

TURBULENT MASS TRANSFER AND RATES OF COMBUSTION IN CONFINED TURBULENT FLAMES

N. M. Howe, Jr., C. W. Shipman, and Alexander Vranos May 1, 1962 25 p 26 refs

Measurements of time-mean reaction rate and of coefficients of turbulent mass transfer throughout the combustion zone of confined turbulent flames are reported. The flames studied were of homogeneous, stoichiometric mixtures of propane and air and were stabilized on cylindrical flameholders in a 3- × 1-inch duct. Combustor inlet velocities of 60, 100, and 175 ft./sec. were used. The primary data consisted of a complete mapping of static and impact pressures, and of chemical composition throughout the zone studied. Densities, velocity components, and mass fractions of the various species could be computed from these data. Reaction rates were obtained by means of the appropriate material balance equation. Turbulent mass transfer coefficients were obtained by means of a material balance equation applied to a radioactive tracer injected from a simulated line source upstream of the combustion zone. Author

N63-16261 Aerojet-General Corp. Ordnance Div., Downey, Calif.

STUDY OF SUSCEPTIBILITY OF SOLID COMPOSITE PROPELLANTS TO EXPLOSION OR DETONATION Final Report

T. G. Owe Berg Apr. 12, 1963 89 p 211 refs

(Contract NOrd 18487)

(Rept. 0253-05(01)FP)

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3. THE EFFECT OF ε-CARBIDE ON THE PASSIVITY OF STEEL IN NITRIC ACID SOLUTIONS Appendix C T. G. Owe Berg p 1–13 38 refs (See N63-16264 13-18)

N63-16262 Aerojet-General Corp. Ordnance Div., Downey, Calif.

THE MECHANISM FOR THE INITIATION OF DETONATION IN SOLID EXPLOSIVES Appendix A

T. G. Owe Berg *In its* Study of Susceptibility of Solid Composite Propellants to Explosion or Detonation Final Report, Apr. 12, 1963 Apr. 1961 p 1–21 130 refs (See N63-16261 13-26)

(Spec. Rept. 1310-62(01)SP)

Evidence on the chemical effects of shock and the conditions for the initiation of detonation of solid explosives by shock, as well as rate data on the decomposition of solid explosives, are reviewed. It is concluded that the initiation is caused by certain species, primarily H and OH and secondarily by HNO and HONO, formed by the shock and by reactions during the induction period. The role of the latter species is to catalyze rearrangement in the solid, presumably by the formation of suitable structures. Author

N63-16263 Aerojet-General Corp. Ordnance Div., Downey, Calif.

INITIATION OF EXPLOSIVES BY FRICTION Appendix B

T. G. Owe Berg, L. R. Codner, and W. C. Joe *In its* Study of Susceptibility of Solid Composite Propellants to Explosion or Detonation Final Report, Apr. 12, 1963 Mar. 1962 p 1–14 43 refs (See N63-16261 13-26)

(Spec. Rept. 1310-62(02)SP)

Experiments have been conducted on identification of the pertinent variables in the initiation of explosives by friction. Nitrogen iodide was initiated by touching it with various metals and alloys and with glass, and also by exposure to fumes from nitric acid decomposed by stannous chloride, and to drops of acids. Hydrogen peroxide gave violent decomposition but no detonation. Ammonia inhibits detonation. The sensitivity to touch was highest with aluminum and copper, lowest with stainless steel and glass. Detonation was preceded by an induction period. The sensitivity increased with repeated touching. It is concluded that initiation is effected by reactions with the atmosphere on the new surfaces formed in fracture and abrasion. The mechanism of initiation by friction is similar to that for the initiation by other means, e.g., impact, shock, and electric discharge. Author

N63-16324 McGill U. Hypersonic Propulsion Lab., Montreal (Canada)

SPONTANEOUS COMBUSTION OF HYDROGEN IN HOT AIR AT AN INITIAL MACH NUMBER OF 3.86

A. M. Valenti Oct. 1962 77 p 38 refs

(DRB Grant 9550-06)

(Rept. 62-7; Supersedes Rept. 62-3)

An experimental study of supersonic combustion has been performed using the McGill University HT-1 pebble-bed heated wind tunnel. Supersonic combustion was achieved in a stainless-steel combustion tube and in a free jet issuing from the tube. Due to fuel mixing and ignition delay time, the combustion occurred mainly toward the end of the combustion tube. Computer programs were written for the I.B.M.-1410 digital computer to calculate test conditions and to compute Mach number, and pressure and temperature variation in the tube, with and without combustion, and including boundary-layer correction. Comparison of the computed static-pressure change due to combustion with the experimental results indicates a high combustion efficiency. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

***For related information see:* 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.**

N63-15766 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

CHARGE-EXCHANGE EFFECTS ON THE ACCELERATOR IMPINGEMENT OF AN ELECTRON-BOMBARDMENT ION ROCKET

William R. Kerslake Washington, NASA, May 1963 45 p 10 refs (NASA TN-D-1657) OTS: $1.25

A systematic investigation of accelerator-grid-ion impingement was made with electron-bombardment ion rockets operated over a range of propellant utilization efficiencies from 0.11 to 0.95. Three ion rockets of 5, 10, and 20 centimeters in diameter were used to produce mercury-ion beams of 0.01 to 0.55 amperes at net accelerating potentials of 600 to 7000 volts. Trends of experimental

impingement values were predicted by ion charge-exchange equations, particularly below propellant utilization efficiencies of 0.6. Discrepancies between experimental and predicted values were probably caused by direct impingement ions. Calculations were made to estimate the maximum lifetime of a molybdenum accelerator grid based upon the rocket operation parameters, charge-exchange equations, and the measured erosion rate of an endurance run. The experimental work was conducted in a 5-foot-diameter, 16-foot-long vacuum tank. Author

N63-15767 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NUMERICAL EVALUATION OF ION-THRUSTER OPTICS
Vladimir Hamza and Edward A. Richley Washington, NASA, May 1963 42 p 11 refs
(NASA TN-D-1665) OTS: $1.25

A numerical solution of the two-dimensional Poisson equation with mixed boundary conditions is presented. Examples of analysis of four variations in an electrostatic thrustor configuration are included, and results are compared. Solution of the matrix equation (obtained from finite difference equations) by the Cyclic Chebyshev Semi-Iterative method is described along with the effect of the relaxation factor on the rate of convergence. An estimate of the space-charge-density function is first obtained from the Laplacian potential distribution and the equations-of-motion. The solution of the Poisson equation is then accomplished by a method of successive approximations. A suppression-factor method of dealing with the typical problem of overestimation of the first-order space-charge-density function is discussed. Of particular interest is the space-charge-limited current calculation. This calculation is discussed in detail, and the accuracy of the solution is compared with analytical results for flow between concentric cylinders. The results of the analysis are compared with data obtained from an experimental thrustor. Author

N63-15905 Atomics International, Canoga Park, Calif.
ELECTRIC PROPULSION APPLICATIONS FOR SNAP SYSTEMS
C. J. Morse Apr. 6, 1962 42 p 12 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7085) OTS: $1.00

The application of SNAP systems to electric propulsion has been investigated. A review is given of the basic analysis involved in establishing optimum power levels and payload capabilities for electric spacecraft, and several typical missions are analyzed to determine the usefulness of the SNAP systems which are under development or systems which are based on the current SNAP technology. In general, it is found that SNAP power units in the range of 60 to 180 kw offer significant mission capability when used in conjunction with initial spacecraft weights of about 10,000 lb in a low-level orbit. Author

N63-15911 Aerojet-General Corp. Solid Rocket Plant, Sacramento, Calif.
DIFFUSION BONDING TO TUNGSTEN ALLOYS Final Report, Aug. 1, 1961 through July 31, 1962
G. K. Hickox Nov. 15, 1962 91 p 11 refs
(Contract DA-04-200-ORD-1077)
(Rept. 0433-01F; WAL-TR-465.54/4)

This report describes the work performed in a study of diffusion banding to tungsten alloys. The program included investigations of brazing fundamentals, tungsten forming and recrystallization behavior, brazing filler metals, and diffusion treatments. Final evaluation of the diffusion-bonding concept was performed by the fabrication and firing of two solid-rocket motors with diffusion-bonded nozzles. Author

N63-15923 David Taylor Model Basin. Hydromechanics Lab., Washington, D. C.
EFFECT OF AXIAL POSITION OF PROPELLER ON THE PROPULSION CHARACTERISTICS OF A SUBMERGED BODY OF REVOLUTION
John L. Beveridge Mar. 1963 53 p 13 refs
(DTMB-1456)

The propulsion performance of a submerged body of revolution was determined when the axial clearance between a stern propeller and the body was varied. Theoretical and experimental results indicate that variations, within the range of investigation, in the longitudinal position of stern propeller do not critically affect the propulsive coefficient. In addition to these results, calculation of the propellers and the thrust deduction is discussed, and experimental results obtained from numerous wake traverses are presented. Author

N63-15942 Atlantic Research Corp., Alexandria, Va.
IMPROVEMENT OF THE USEFULNESS OF PYROLYTIC GRAPHITE IN ROCKET MOTOR APPLICATIONS Quarterly Progress Report, June 1, 1962 to Sept. 1, 1962
James D. Batchelor Sept. 1962 20 p
(Contract DA-36-034-ORD-3279 RD)

The feasibility of producing pyrolytic graphite coatings for uncooled rocket nozzles at substrate temperatures below 2000° C was investigated. The most significant method of improving the microstructure of lower temperature coatings was found to be the use of resin precoat treatment of the substrate. The effect of deposition processing variables on the quality of the pyrolytic graphite coating produced was investigated by motor firing tests using subscale nozzles. The results indicate that the presence of a low thermal conductivity coating, such as pyrolytic graphite, impedes heat flow into the nozzle but produces an extremely rapid rise in the surface temperature. M.P.G.

N63-15989 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT TRENDS OF LIQUID PROPELLANT ENGINES
A. A. Mc Cool and Keith B. Chandler *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 289-307 1 ref (See N63-15976 13-01)

The historical development of the liquid propellant rocket engine is summarized. The design and operation of the V-2(1942), the Redstone A-7(1952), the Jupiter S-3D(1956), the Saturn H-1(1958) and the Saturn F-1(1961) are described. Each of these engines represents a performance advantage and a reduction in complexity over the preceding engine. The progress made over the past twenty years in specific impulse, thrust-to-weight ratio, chamber pressure, and thrust is charted. Future gains are expected from the use of tap-off and secondary injection techniques, and from improved nozzle concepts. M.P.G.

N63-15991 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRIC PROPULSION: A NEW TECHNOLOGY
Ernst Stuhlinger, Gerhard B. Heller, Robert N. Seitz, and George C. Bucher *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 319-347 33 refs (See N63-15976 13-01)

The rapid development of electric thrust devices is described. The most spectacular advances were made in ion engine technology. Total energy expenditure per ion pair has decreased from 35,000 ev in 1958 to about 600 ev, power utilization efficiencies of up to 80% have been achieved, and improvements in ion current per unit area are reported. Further study is required, however, to establish techniques for neutralizing the ion beam once it leaves

the source. Some advances in electric arc engines involve the use of a hydrogen–lithium fuel mixture which produces a lower arc voltage and thus reduces electrode erosion problems, and the use of a.c. power, with negligible ballast resistance and without power rectification losses, for stable operation. Three types of plasma engines are being studied: the pulsed plasma accelerator, the crossed field accelerator, and the traveling wave accelerator. Some of these electric thrust devices have reached the actual test flight stage. Until thermionic and plasma dynamic converters with sufficiently high efficiencies become available, the nuclear turbo-electric power supply system employing Rankine vapor heat cycle power conversion will probably be used. A master plan for a manned Martian expedition using electrically propelled spacecraft is outlined. M.P.G.

N63-15992 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PERFORMANCE ANALYSIS OF ELECTRICAL PROPULSION SYSTEMS
R. D. Shelton, W. G. Johnson, Billy P. Jones, and J. C. King *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 349-376 6 refs (See N63-15976 13-01)

The primary parameters which characterize the performance of electrical propulsion systems are identified, their influence on the general mission capability is evaluated, and their association with the development of particular subsystems is established. Two complementary problems are associated with improving electrical propulsion performance: (1) improving the utilization efficiency of both available prime electric power and fuel and (2) increasing the available prime power to vehicle mass. The first will be solved primarily through improvement in thrustors, and the second through improvement in prime electric power sources and spacecraft designs. Both areas are considered in detail in relation to ion thrust units and arc thrust units. M.P.G.

N63-15993
A PROPOSED ELECTRIC SPACESHIP ENGINE
Hermann Oberth *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 377-396 1 ref (See N63-15976 13-01)

An electric spaceship engine that ejects electrons and ions and creates an electric wind consisting of particles of colloidal size is presented. The operation of the engine and its various components is described. Simple methods of calculating the propulsion efficiency are presented, and losses due to dispersion, ionization, scattering, and inequalities in particle mass are considered. Useful missions for colloidally propelled spaceships are discussed. M.P.G.

N63-16323 Cordo Chemical Corp., Mobile, Ala.
ABLATIVE PROPERTIES OF MATERIALS MOLDED AT EXTREMELY LOW PRESSURES Report of Investigation
Mar. 15, 1963 16 p 2 refs

A materials evaluation project has been undertaken to develop ablative data for low-pressure-molded plastic laminates. The materials selected were previously proved acceptable when molded at high pressures, and the ablative behavior of the low-pressure-molded panels was compared with the accepted standards of behavior for high-pressure-moded materials. Tests were performed to determine the performance of various ceramic-filled resin panels with high silica, graphite, and carbon fabric reinforcements molded at low pressures when subjected to ablation in the exhaust flame jet of a gaseous-fueled rocket engine. Tables of ablative performance data are given. D.E.R.

N63-16337 Naval Air Material Center, Aeronautical Engine Lab., Philadelphia, Pa.
EFFECTS OF JET FUEL CONSTITUENTS ON COMBUSTOR DURABILITY
C. C. Mc Clelland May 15, 1963 39 p 7 refs
(NAEC-AEL-1736)

The possibility of reducing jet-engine-combustor-liner temperatures by controlling the fuel properties which cause excessive flame radiation was investigated. A J79 combustion chamber was tested with twelve fuels at two inlet temperatures and three heat-release rates. The results were similar to those for a J57 combustor except for the effects of design variables. The data showed a relationship of flame radiation and liner temperatures with fuel luminometer number and hydrogen content. Polycyclic aromatic hydrocarbons were found to be more severe than monocyclic. Liner temperatures can be improved by fuel selection, but the effect of fuel properties is limited and further improvement must be sought in combustor design. Author

N63-16338 Ion Physics Corp., Burlington, Mass.
Quarterly Progress Report No. 1, June 1-Aug. 13, 1962 [CONDENSATION COLLOIDAL ION ENGINE AS A SOURCE TO PRODUCE COLLOIDAL IONS SUITABLE FOR USE AS THE PROPELLANT IN AN ELECTRO-STATIC PROPULSION ENGINE]
A. Lucile Cox. Sept. 17, 1962 82 p refs
(Contract AF 33(657)-8743)

Experimental studies of three types of ionizers were conducted. Ion extraction from the contained arc is difficult, so that only low currents and charge-to-mass ratios can be obtained with this type of source. The free arc and corona ionizers produce useful ion currents, but the investigation of these ionizers indicates a need for beam focusing and removal of electrons from the colloidal ion beam in the growth region. A new colloidal ion source has been fabricated to study the effect of magnetic fields in the ionization region. It can also accommodate propellant materials which require higher operating temperatures. This source will be operated in a new vacuum tank now available. A collector has been fabricated to permit accurate evaluation of mass beam collimation. A quadrupole mass spectrometer has been employed in some experiments, but no charge-to-mass ratio measurements have been achieved with it yet. Hot-wire anemometers have been obtained to investigate a new technique for detecting the presence of colloidal material. Tables and graphs of flow data have been prepared for use over the mass flux range of interest in the present study. Analysis of the nucleation process indicates that sodium vapor would form a considerable amount of uncharged colloidal material as well as the charged particles. Cadmium and mercury seem much more likely to undergo preferential ionic nucleation. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

***For related information see:* 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.**

N63-15828 Smithsonian Astrophysical Observatory, Cambridge, Mass.
SOLAR RADIO BURSTS OF SPECTRAL TYPES II AND IV: THEIR RELATIONS TO OPTICAL PHENOMENA AND TO GEOMAGNETIC ACTIVITY
Barbara Bell (Harvard Coll. Obs.) 1963 22 p 35 refs
Uts Contrib. to Astrophysics, v. 5, no. 15)
GPO: $0.30

Solar radio bursts of spectral types II and IV, observed in the years 1957–1960, are discussed in relation to flares, the magnetic class of the associated sunspot, the north-south asymmetry, and to geomagnetic and solar proton (PCA) effects. A total of 96 type IV and 197 type II bursts were studied. Author

N63-15890 Durham U. (Gt. Brit.)
VARIATIONS OF THE SEA LEVEL MUON FLUX Technical Report
F. Ashton, J. B. M. Pattison, and A. W. Wolfendale Jan. 20, 1963 126 p 36 refs
(Contract AF 61(052)-27)
(AFCRL-63-401)

Studies of cosmic ray muons have been made with a spectrograph comprising a solid iron magnet, Geiger counters, and neon flash-tubes. The characteristics of the instrument are described. Time variations in the vertical direction have been studied and are attributed to variations of meteorological parameters. Momentum spectra have been measured in the range 2 to 500 gev/c for zenith angles between 77.5° and 90°. The results are interpreted as showing that most muons in this range came from pions; an upper limit of 0.55° is placed on the K/π ratio for proton-air nucleus collisions of 700 to 30,000 gev. The positive-negative ratios confirm a near constant value of 1.2 over the range of muon energies 10 to 200 gev; a likely explanation is that there is an increase in the fluctuations of multiplicity in high energy collisions. Author

N63-15944 Minnesota U. Cosmic Ray Group, Minneapolis
THE PRODUCTION OF FREE ELECTRONS IN THE IONOSPHERIC *D* LAYER BY SOLAR AND GALACTIC COSMIC RAYS AND THE RESULTANT ABSORPTION OF RADIO WAVES
William Webber [1962] Repr. from J. Geophys. Res., v. 67, no. 13, Dec. 1962 p 5091–5106 27 refs
(NASA Grant NsG-281-62)
(CR-61)

The behavior of the *D* layer under bombardment by solar and galactic cosmic rays of energy greater than a few mev is discussed. In particular, the variation with incident particle flux of the ionospheric parameters that determine the equilibrium electron density is deduced by means of the measurements of midday and midnight absorption of cosmic radio noise corresponding to identical fluxes and spectrums of solar cosmic rays (protons). The values of the ionospheric parameters so obtained are then used in conjunction with differential solar proton spectrums of the form $dJ/dP = Ke^{-P/P_0}$ to determine the electron densities and resultant absorption effects of cosmic radio noise in the range 3 to 30 mc/s. Special attention is given to weak absorption effects in the ranges 3 to 10 mc/s and to problems relating to the measurement of small, low-energy solar-particle events and to the changes in the low-energy portion of the spectrum of galactic cosmic rays. Author

N63-15964 International Geophysical Year World Data Center A (Solar Activity). High Altitude Observatory, Boulder, Colo.
MC MATH-HULBERT OBSERVATORY WORKING LIST OF FLARES AND DAILY FLARE INDEX FOR 1961
Helen W. Dodson and E. Ruth Hedeman Mar. 15, 1963 53 p 6 refs
(IGY Solar Activity Rept. No. 21)

Solar flares for 1961 are listed chronologically. Times are given for the beginning and the end of the flare, as well as for the maxima of the flare. An importance category is assigned on the basis of reported measurements of area and intensity. Heliographic coordinates and the total number of stations reporting are also given. The number of flares reported for 1961 totaled 1,129. The month with the greatest number of flares was July, with 165 flares. J.A.J.

N63-16009 Iowa State U., Iowa City
OBSERVATION OF GALACTIC AND SOLAR COSMIC RAYS WITH EXPLORER 7
Wei Ching Lin and James A. Van Allen *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 725-747 12 refs (See N63-15976 13-01)
(Supported by NASA and ONR)

The successful operation of the single set of radiation detectors on Explorer 7 permitted observations of: (1) the lower regions of the inner and outer radiation belts, (2) primary cosmic-ray intensity near the earth, and (3) the arrival of solar cosmic rays. The detector was a simple instrument consisting of two geiger tubes of different size and different shielding. The data obtained during the period October 13, 1959, to February 17, 1961, at high latitudes in the altitude range 550 to 1100 km are summarized. Observational data that was secured on twenty solar cosmic ray events occuring during this period are discussed. M.P.G.

N63-16034 California U., Livermore. Lawrence Radiation Lab.
NEAR-EARTH CHARGED-PARTICLE BACKGROUNDS MEASURED WITH POLAR ORBITING SATELLITES
F. D. Seward and H. N. Kornblum, Jr. Mar. 25, 1963 44 p 8 refs
(Contract W-7405-eng-48)
(UCRL-6693) OTS: $1.00

In 1961, a detector system was flown on four Air Force satellites. This system contained two scintillation counters, each sensitive to charged particles in different energy ranges. Counting rates as a function of satellite position are presented for both of these counters. Primary cosmic rays of very high energy were seen. The shape of these cosmic-ray plateaus as measured in September 1961 is illustrated. Two regions of high counting rate were observed at an altitude of about 400 km over the South Atlantic. It is shown that these correspond to the edges of the inner and outer radiation belts. By comparing these data with counting rates of other detectors aboard the flights, it is shown that the edge of the inner belt contains a penetrating component (high-energy-protons) and the edge of the outer belt consists of much softer radiation. Counting rates of the detector sensitive to low-energy particles were observed to fluctuate rapidly and irregularly in a region surrounding each magnetic pole. This region corresponds to the visible auroral zone. Evidence is presented showing that this radiation consists of low-energy electrons traveling so that they will enter the earth's atmosphere. Author

N63-16293 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STUDY OF THE HYDROGEN, HELIUM, AND HEAVY NUCLEI IN THE NOVEMBER 12, 1960, SOLAR COSMIC RAY EVENT
S. Biswas, C. E. Fichtel, and D. E. Guss Washington, NASA, May 1963 33 p 29 refs
(NASA TN-D-1764) OTS: $1.00

The composition and energy spectra of solar cosmic rays from the November 12, 1960, solar flare were studied by using rocket-borne nuclear emulsions. The abundances of hydrogen, helium, carbon, nitrogen, oxygen, neon, and larger nuclei were determined, and upper limits were set for light nuclei ($3 \leq Z \leq 5$) and fluorine nuclei. The relative numbers of helium, light, medium ($6 \leq Z \leq 9$), and large ($Z \geq 10$) nuclei in the solar beam were found to be 680 ±110, <0.1, 10, and 1.0 ±0.3, respectively. The composition was similar to that of the solar atmosphere, as determined by spectroscopic means, for those elements where a comparison could be made but was markedly different from that of galactic cosmic rays. Author

N63-16329 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHIELDING: AN ANNOTATED BIBLIOGRAPHY
William L. Hollister, comp. Feb. 1962 171 p 338 refs
(Contract AF 04(647)-840)
(S8-62-2; AD 274015)

The following bibliography was compiled in connection with a study of radiation hazards upon the lunar surface. The bibliography includes works on the subject of reactor shielding, both on land and in nuclear-powered space vehicles, and shielding against trapped radiation belts, cosmic rays, and solar flares. Both theoretical and empirical studies are included. Author

N63-16335 Lockheed Missiles and Space Co. Physical Sciences Lab., Sunnyvale, Calif.
PROTON FLUX MEASUREMENTS FROM SATELLITES 1961 SIGMA-1, 1961 ALPHA DELTA-1, AND 1962 KAPPA-1 NEAR THE PEAK OF THE INNER VAN ALLEN BELT
R. V. Smith, P. C. Fisher, W. L. Imhof, R. D. Moffat, and J. B. Reagan June 1962 35 p 11 refs
(Contract AF 19(604)-8028)
(LMSC-2-08-62-2)

Measurements of the high-energy proton flux in the inner Van Allen belt have been made at magnetic altitudes between 2,800 and 3,900 km on three satellites in polar orbit. The detectors consisted of scintillation counters having proton thresholds ranging from 25 to 128 mev provided by their shield thickness, and a geiger counter with a proton shield thickness of 60 mev. The counting rate of each detector was determined from the telemetered output of a logarithmic count-rate meter. Several passes at various longitudes show the latitude dependence of the proton flux and indicate, within 20 degrees of the magnetic equator, a higher flux and a steeper altitude dependence than had been expected. Comparison of the geiger counter and 60-mev scintillator rates indicates that the particles being counted are protons. Comparison of the scintillator rates yields a proton spectrum which changes with both latitude and altitude. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-15800 General Electric Co. Missile and Space Vehicle Dept., Philadelphia
VENUS ATMOSPHERE PHYSICAL PROPERTIES
J. Brown Apr. 24, 1962 27 p 1 ref
(PIR-7250-26A; supersedes PIR-7250-26)

Tables giving the various physical properties of the Venus atmosphere are presented. These tables supersede those given in PIR 7250-26. J.A.J.

N63-15805 General Mills Electronics Group, Minneapolis, Minn.
SPUTTERING EFFECTS ON THE MOON'S SURFACE Fourth Quarterly Status Report, Jan. 18–Apr. 17, 1963
G. K. Wehner Apr. 17, 1963 29 p 45 refs Submitted for Publication
(NASA Contract NASw-424)
OTS: $2.60 ph, $1.07 mf

With solar-wind data, especially from Mariner II, and laboratory sputtering-yield measurements for H^+ and He^+ ion bombardment on metal, oxide, and stone targets, the sputtering rates for bodies in earth orbit around the sun are estimated to be 1.1 Å/year for Cu and 0.4 Å/year for Fe or stones. The moon must have lost a layer roughly 17 cm thick in 4.5×10^9 years. Micrometeorites must have a very limited lifetime which is of the order of 25,000 years for a micron-size particle. Author

N63-15852 National Aeronautics and Space Administration, Washington, D.C.
THE DISTANT GEOMAGNETIC FIELD. 3. DISORDER AND SHOCKS IN THE MAGNETOPAUSE
I. J. Abrams (Space Technology Labs.) and C. P. Sonett Repr. from J. Geophys. Research, v. 68, no. 5, Mar. 1, 1963 p 1233–1263 19 refs

The procedure for analysis of fluctuation phenomena in the geomagnetic field is extended to study finite disturbances in amplitude and direction at distances of 12.3 to 14.6 earth radii on the sunlit hemisphere of the magnetopause (magnetospheric-interplanetary transition region). The appearance of large and small excursions in both field amplitude and direction suggests a highly stirred or turbulent plasma of $\beta \sim 1$ in this region of space on the day of this flight. The directional changes are generally reversals in polarity and precede the most extreme pulses. The data are characterized by many finite-amplitude pulses suggestive of collisionless waves such as might typify the microstructure of a shocked region in the collisionless domain. These pulses have crests of extreme sharpness, suggesting the possibility of radiative dissipation. Moreover, the front-back asymmetry, together with satellite pulse structure, is consistent with damping by either the mechanism of Gardner and others, or that of Petschek. Power spectrums of both longitudinal and transverse excitation have been computed. The longitudinal (compressive) energy density is generally $\sim 10^{-9}$ erg/cm^3; the transverse energy density is $\sim 10^{-10}$ erg/cm^3. The longitudinal half-power frequency increases from 2 to 4 rad/sec in traversing outward through this segment of the field. The large depression in power and the arithmetic-mean field values for the greatest distance suggest a geomagnetic or interaction termination at 14.6 Re. Arguments are given to show that, within the scope of this experiment, the planar or two-dimensional view of these phenomena do not qualitatively modify the observations. The results, regarding both the macroscopic and microscopic character, are discussed extensively in part 4 of this series. In the discussion of power spectrums the assumption $\delta H/\delta t \ll \omega H$ (the unimportance of folded contributions) is adhered to and forms the framework for certain of the conclusions discussed. Author

N63-15915 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
LUNAR REFERENCE COORDINATES
C. F. Campen, Jr. Dec. 29, 1961 7 p
(NASA Contract NASw-6)
(JPL-TM-33-72) OTS: $1.10 ph, $0.80 mf

Two distinct conventions have been defined by the International Astronomical Union General Assembly: the Astronomical Convention and the Astronautical (or Cartographic) Convention. The Astronomical Convention will retain the inversion of north and south on astronomical photography but will substitute the designations "right" and "left" or "leading edge" and "trailing edge" for "east" and "west." The Astronautical Convention will use the designation of "east" and "west" and latitude–longitude division, as on earth, for the moon and other planets. J.A.J.

N63-15920 Aerospace Corp. Physical Research Lab., El Segundo, Calif.
ON ALIGNMENT OF SUN, EARTH, AND SATELLITE
P. O. Bell Jan. 25, 1962 44 p
(Contract AF 04(647)-930)
(TDR-930(2352)TR-1; DCAS-TDR-62-7)

This paper reports the results of an investigation of the relations among the launch parameters of an earth satellite and the

time and position of alignment of the sun, the earth, and the satellite. The effects of variations of the launch conditions upon the satellite's time of transit across the solar disc are determined. Computations have been made on the IBM-7090 digital computer. Author

N63-15936 Cornell U. Center for Radiophysics and Space Research, Ithaca, N.Y.

A THEORETICAL PHOTOMETRIC FUNCTION FOR THE LUNAR SURFACE

Bruce W. Hapke Feb. 1963 50 p 16 refs Submitted for Publication

(NASA Grant NsG-119-61)

(CRSR-138) OTS: $4.60 ph, $1.70 mf

A formula which describes the observed photometric properties of the lunar surface is derived theoretically. Functions for both the differential and integral brightness are obtained. The model surface on which the derivation is based consists of a semi-infinite, porous layer of randomly-placed, obscuring objects; these objects are suspended in depth in such a manner that the interstices which separate them are interconnected. A layer of fine, loosely-compacted dust is in the category of surfaces described by this model, but volcanic foam is not. The shape of the photometric curve depends on the fractional void volume. Bulk densities of the order of one-tenth that of solid rock are implied for the upper layers of the surface of the moon. Author

N63-15983 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EVOLUTION OF EARTH-LUNAR TRANSPORTATION SYSTEMS

H. H. Koelle *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 121-137 (See N63-15976 13-01)

A typical model of a lunar transportation system is developed. It is found that soon after the first manned lunar landing, the transportation system will undergo refinement. Seven modes of operation are considered that cover two decades: the large earth launch vehicle, large earth launch with a rendezvous in space, nuclear launch vehicle, recoverable and reusable launch vehicle, nuclear ferry vehicle after earth launch, refueling on the moon's surface, and a chemical, nuclear combination refueling on the moon. Three phases of development of the transportation system are forecast: (1) all-chemical, expendable rocket vehicles with direct entry into earth's atmosphere, (2) expendable vehicles with a nuclear orbit-to-orbit stage and direct hyperbolic entry, and (3) all-chemical, reusable vehicles with a nuclear ferry vehicle from orbit-to-orbit and return. Costs are approximated and transport volumes are estimated. D.E.R.

N63-16014 RAND Corp., Santa Monica, Calif.

A POSSIBLE APPROACH TO SCIENTIFIC EXPLORATION OF THE PLANET MARS

E. A. Steinhoff *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 803-836 23 refs (See N63-15976 13-01)

The use of Phobos (the natural satellite of Mars) as an orbiting space station for the Mars expedition prior to actual manned landing on Mars is proposed. Trajectory, propulsion, and logistic analyses indicate that the Phobos landing would require only the same mission capability as the manned lunar landing. The Phobos approach offers the further advantages of observation and mapping of Mars surface, Mars landing-site selection, and delivery of cargo, supplies, and base modules by remote control before the first manned vehicle lands. The achievement of a self-contained-base capability and the ability to extract water from rocks could lead, within present technology, to production of cryogenic hydrogen and oxygen on Phobos and Mars, thus relieving the need to transport fuels for return flights. With the reduction in fuel requirements, return cargoes could be brought to Earth. This transfer approach may lead to earlier exploration and utilization of Mars than could be expected by waiting for nuclear or ion propulsion systems to become available. M.P.G.

N63-16121 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

THE MAGNETIC FIELD AND ROTATION PERIOD OF VENUS

G. M. Idlis and S. O. Obashev June 29, 1962 8 p 27 refs Transl. by B. W. Kuvshinoff from Izvest. Astrofiz. Inst. Akad. Nauk Kazakh. SSR (Alma Ata), v. 12, Dec. 1961 p 91-94

(Contract NOw-62-0604-C)

(TG-230-T304)

An estimation of the approximate magnetic field moment and the rotation period of Venus is given. From spectroscopic observations, radioastronomical observations, radiometric measurements, and radio emission analysis, the geometric mean of the collected values indicates a time of approximately 14 days for the rotation period of Venus. The magnetic fields and rotational periods of heavenly bodies are closely related. Venus is comparable to Earth in mass, dimension, and structure. By relating the rotation period of Venus in terms of Earth days, the magnetic field of Venus is estimated to be 4×10^{24} gauss cm^3. N.E.A.

N63-16173 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

SPACE PROGRAMS SUMMARY NO. 37-20, VOLUME IV FOR THE PERIOD FEBRUARY 1, 1963 TO MARCH 31, 1963. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT

Apr. 30, 1963 235 p 165 refs

(NASA Contract NAS7-100)

(JPL-SPS-37-20, Vol. IV) OTS: $15.50 ph, $6.95 mf

The following subjects are covered: systems analysis, spacecraft secondary power, guidance and control analysis and integration, guidance and control research, development support and advanced technical studies, structures and dynamics, fluid mechanics and thermodynamics, solid propellant engineering, polymer research, propulsion research, liquid propulsion, communications systems research, communications elements research, space instruments development, lunar and planetary studies, chemistry, fluid physics, and physics. J.A.J.

N63-16190 California U., Berkeley. Space Sciences Lab.

THE CRATERS IN THE LUNAR WALLED PLAIN PTOLEMAEUS

Ann Palm and Robert G. Strom Repr. from Planet. Space Sci., v. 11, 1963 p 125-134 12 refs

(NASA Grant NsG-145-61)

Diameters of craters in the lunar walled plain Ptolemaeus and in vicinal equal-area terrae (highland surfaces) were measured by means of some of the best lunar photographs available at this time. Statistical analyses of the data lead to the conclusion that the ghosts, which are partially submerged craters, and the post-Ptolemaean craters came from distinctly different populations. A range of relative rates of formation of the two types of craters was deduced from areal densities and assumed times of terminal flooding, which represents a logical fiducial point. Since Ptolemaeus is presumably an ancient feature, the rate of formation of the early ghosts exceeded the subsequent rate at which the post-Ptolemaean craters were produced by one or two orders of magnitude. On the basis of the relative surface densities, age, and frequency distributions of the total Ptolemaean and adjacent terrae craters, it is tentatively inferred that these craters may have had a similar history. Author

N63-16198 Kyoto U. Inst. of Astrophysics (Japan)

THE HEAT BALANCE ON THE SURFACE OF MARS

Akira Hattori 1962 8 p 5 refs Repr. from Mem. Coll. Sci., Univ. Kyoto, Ser. A, v. 30, no. 2, art. 2, 1962 p 125–135

(Kyoto U. Inst. of Astrophysics and Kwasan Obs. Contrib. no. 115)

The insolations (for τ = 0, 0.1, 0.2, and 0.3) and the heat loss on the Martian surface for various seasons have been calculated. Then, the heat balance on the surface and the effect of Martian cloud have been discussed. It is shown that the theoretical results agree fairly well with observations. Author

N63-16224 California U., La Jolla

RARE GASES IN THE SUN, IN THE ATMOSPHERE, AND IN METEORITES

Peter Signer (Minnesota U.) and Hans E. Suess Repr. from Earth Science and Meteoritics, Chap. 13, 1963 p 241–272 43 refs

(NASA Grant NsG-322-63)

The solar abundances of the rare gases are reviewed and mechanisms discussed which can be responsible for the terrestrial rare-gas abundances. New data of meteoritic gases are presented. The data on meteoritic primordial gas strongly indicates that the meteorites contain a mixture of primordial rare gases of two different compositions. Carbonaceous and enstatite chondrites contain predominantly fractioned primordial gases of a composition similar to the terrestrial rare gases, whereas the He- and Ne-rich meteorites contain large amounts of an unfractionated component close to solar composition. New estimates of the cosmic abundance of the rare-gas nuclides, derived from the primordial rare gases in meteorites, agree well with those derived previously from other evidence. In Kapoeta, a light component is found which contains no primordial gases. Hvittis is found to contain primordial gases in concentrations typical for enstatite chondrites. Author

N63-16254 Manchester U. (Gt. Brit.)

LUNAR PHOTOMETRIC AND TOPOGRAPHICAL ANALYSIS Annual Summary Report No. 2, July 1, 1961–June 30, 1962

T. W. Rackham Oct. 1962 12 p 2 refs

(Grant AF EOAR-61(052)-496)

This report outlines the activities of the Manchester Lunar Photographic Team at the Pic-du-Midi Observatory, during the period 1 July 1961 to 30 June 1962. Author

N63-16258 National Aeronautics and Space Administration, Washington, D.C.

TABLES FOR ECCENTRIC AND TRUE ANOMALY IN ELLIPTIC ORBITS

Jack T. Kent, George B. Taack, Jr., and David C. Larson (Texas A. and M. Coll.) 1963 206 p

(NASA TR-R-158) GPO: $1.50

These tables have been compiled to facilitate the computation of orbits of spectroscopic and visual binaries and of small planetary objects such as asteroids and satellites. The eccentricity ranges from 0.01 to 1.00. The accuracy of the tables is eight digits. Author

N63-16277 Naval Research Lab., Washington, D.C.

THE BRIGHTNESS TEMPERATURE OF VENUS AT 1.35 CM

J. E. Gibson and H. H. Corbett Apr. 11, 1963 9 p

(NRL-5937)

Measurements of the radiation of the planet Venus at 1.35-cm wavelength are being carried out in order to investigate the spectrum between previous millimeter- and centimeter-wavelength observations. The results obtained near lower conjunction indicate little change in brightness compared to 3-cm wavelength, and some of the resulting implications are discussed. Author

N63-16300 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Luftfahrzeugführung, Brunswick (W. Germany)

[FLIGHT PATH TRACKING EQUIPMENT OF THE DFL–DEVELOPMENT, OPERATION, AND COMPARISON] DIE FLUGBAHNMESSANLAGEN DER DFL–AUSBAU, EINSATZ, UND VERGLEICH

O. Weber and A. Wallenhauer Oct. 1961 268 p 26 refs In German

(DFL-169)

The German Aeronautical Research Institute has made available, for flight path tracking, two recording theodolites, one radar tracker, and a self-built zenith camera system. The geometric basis of the measurement and evaluation methods used by the German Aeronautical Research Institute, as well as the technical qualities of three flight-path-testing installations, is reviewed in the light of a general survey of methods for flight-path tracking. The installations are synchronized. Results of the first operations and advantages and disadvantages of the flight-path-testing installations, as well as data processing are discussed. Trans. by I.v.L.

N63-16321 Eastman Kodak Co. Apparatus and Optical Div., Rochester, N.Y.

SPACE BACKGROUND STUDY Final Report [February 1, 1962–January 18, 1963]

Walter E. Mitchell, Jr., Phillip E. Barnhart (Ohio State U. Res. Found.), David Flint, William Haynie, and Charles Gramm Apr. 19, 1963 72 p 9 refs

(Contract DA-30-069-ORD-3516; ARPA Order 39-60; Proj. Defender)

(EK/ARD Ed-1003)

The Kodak infrared stellar photometer was installed, maintained, modified, and operated on the 69-inch reflector at the Lowell Observatory and the 32-inch reflector at the Perkins Observatory at Delaware, Ohio. A program of stellar measurements in three infrared wavelength bands to test the validity of a blackbody model of stellar radiation over broad regions of the electromagnetic spectrum is described. Special problems and techniques of data interpretation have been developed and the application of such techniques is used to assess the model. Results of the measurements are given for 24 reliably measured stars in the wavelength regions 2.0 to 2.4 and 3.4 to 4.0 microns, and results of measurements of α Herculis are given in the wavelength region 7.8 to 13.2 microns. Author

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

***For manned space capsules, satellites, and space probes see:* 32 Space Vehicles (Spacecraft).**

***For boosters and rockets see:* 31 Space Vehicles (Launch Vehicles).**

***For related information see:* 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.**

N63-15775 National Aeronautics and Space Administration, Washington, D.C.

AN APPLICATION OF TIME-OPTIMAL CONTROL THEORY TO LAUNCH VEHICLE REGULATION

F. B. Smith, Jr. and J. A. Lovingood (Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.) May 1963 23 p 9 refs

(NASA Contract NASr-27)

(NASA TN-D-1895) OTS: $0.75

A minimum response-time criterion is used in the design of a pitch-attitude controller for a flexible launch vehicle. The criterion is applied to a fourth-order model containing the primary dynamics

of the thirteenth-order vehicle. A collection of open-loop optimal trajectories is used to define a closed-loop control law. Results of an analog simulation are presented which show that this control law properly applied to the flexible vehicle results in good control. Author

N63-15979 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EVOLUTION OF LAUNCH CONCEPTS AND SPACE FLIGHT OPERATIONS

Kurt H. Debus *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 43-61 (See N63-15976 13-01)

The history and current development of launch concepts and spaceflight operations are reviewed. The evolution of the Saturn launch vehicle from the V-2 rocket concept is used as an example. The development of new launch vehicles and spacecraft designs is discussed and future concepts, especially those required for deep space probes, are outlined. The current status and a projection into the future for launch pads and launch complexes are included. D.E.R.

N63-15987 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROBLEMS IN RADIATION SHIELDING FOR SPACE VEHICLES

J. W. Keller, M. O. Burrell, R. D. Shelton, and J. A. Downey III *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 241-260 17 refs (See N63-15976 13-01)

Space-vehicle radiation-shielding problems arise from two sources: (1) propulsion systems using nuclear fission as the energy source; and (2) the radiation present in the space environment, including the high-energy radiation belts of the earth, the background cosmic radiation, the intense radiation associated with solar activity, and the radiation belts around the planets to be explored. The secondary radiation from these sources must also be considered: nuclear reactors produce neutrons which generate gammas in the surrounding media; and the interactions of primary solar protons with the target material set up nucleon-nucleon reactions. The ideal neutron shielding material absorbs as much of the energy as possible and reduces the transmitted flux (hydrogen, carbon); the ideal gamma shielding material provides a large number of electrons per unit volume and a large photoelectric cross section (lead). The most effective electron shield material has a high photoelectric cross section; and the most effective proton shield would be a low-Z material. Other factors which determine the actual choice of shielding materials include the weight and density of the material, and the realistic establishment of allowable radiation dosages for various manned space missions. M.P.G.

N63-15990 Forschunginstitut für Physik der Strahlantriebe, Stuttgart (W. Germany)

ÜBER BALLISTISCHE UND AERONAUTISCHE RAUMFAHRT [CONCERNING BALLISTIC AND AERONAUTICAL SPACE TRAVEL]

Eugen Sänger *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 309-317 4 refs In German (See N63-15976 13-01)

This review of the state-of-the-art of propulsion systems and their applications includes: (1) propulsions systems, with a specific impulse in vacuum of ~280 sec, that use kerosene–liquid oxygen or hydrazine–nitrogen tetraoxide for four-stage rockets; (2) propulsion systems, with a specific impulse in vacuum of ~450 sec, that use liquid hydrogen–liquid oxygen or liquid hydrogen–liquid fluorine for two-stage rockets; (3) propulsion systems with a specific impulse in vacuum of 800 sec to 3000 sec that use nuclear fission with hydrogen, water vapor, or ammonia for space vehicles; and (4) propulsion systems, with a specific impulse of 3000 sec to 30,000,000 sec, that use nuclear fission, nuclear fusion or radiation materials for interplanetary and interstellar space vehicles. I.v.L.

N63-16004 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MANRATING SPACE CARRIER VEHICLES

Joachim P. Kuettner *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 629-639 (See N63-15976 13-01)

The criteria for manrating space vehicles are discussed in terms of design, quality assurance, operations, and emergency conditions. R.C.M.

N63-16159 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

BASE HEAT TRANSFER, PRESSURE RATIOS, AND CONFIGURATION EFFECTS OBTAINED ON A $^1/_{27}$ SCALE SATURN (C-1) MODEL AT MACH NUMBERS FROM 0.1 TO 2.0

John L. Allen and Robert A. Wasko Washington, NASA, May 1963 68 p 10 refs

(NASA TN-D-1566) OTS: $1.75

Heat fluxes at the nozzle-exit plane between the inboard engines varied from 40 to between 300 and 400 Btu/(sq ft)(sec) (for wall temperature of 100° F). On the base shield at the nozzle-throat plane, heat flux varied considerably with configuration, location, and operating conditions. In general, the heat flux was increased by discharging simulated turbopump gases through exhausterators around the outboard engines, and through stacks in the shroud surface that extended less than one-third of the local boundary-layer height. A recessed-base configuration having appreciable base bleed reduced heat fluxes over the Mach number range 0.8 to 2.0 from values between 80 and 20 to less than 5 Btu/(sq ft)(sec) (all at 100° F wall temperature). Author

N63-16275 Lockheed Missiles and Space Co., Palo Alto, Calif.

METEOROIDS AS A POSSIBLE HAZARD TO SPACE VEHICLE OPERATIONS: AN ANNOTATED BIBLIOGRAPHY, 1956-1962

Charles G. Gros, comp. May 1963 44 p 96 refs

(Contract AF 04(647)-787)

(SB-63-1)

This work treats of meteoroids as a possible hazard to space-vehicle operations. Citations to meteors and other interplanetary debris have been included when the material was of relevance to meteoroids as well. Citations to combined environmental parameters affecting the reliability of space vehicles in flight have also been included when meteoroids constituted one of the parameters. The period covered is from 1956 through 1962, with a few earlier citations. Author

N63-16294 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS AT MACH NUMBERS OF 6.0 AND 9.6 OVER TWO REENTRY CONFIGURATIONS FOR THE FIVE-STAGE SCOUT VEHICLE

Paul F. Holloway and James C. Dunavant Washington, NASA, May 1963 52 p 11 refs

(NASA TN-D-1790) OTS: $1.50

Wind-tunnel heat-transfer and pressure distributions have been obtained over two blunt-cone reentry configurations for an angle-of-attack range of 0° to 30° at a Mach number of 6.0, and 0° to 25° at a Mach number of 9.6. The pressure distributions have been compared with modified Newtonian theory for the full

angle-of-attack range. The heat-transfer distributions at an angle-of-attack of 0° are compared with the theory of Lees. Some comments on heat-transfer distributions and the stagnation-point heating level are included. Author

N63-16298 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

THEORETICAL INVESTIGATION OF THE SLIDEOUT DYNAMICS OF A VEHICLE EQUIPPED WITH A TRICYCLE SKID-TYPE LANDING-GEAR SYSTEM

Richard B. Noll and Robert L. Halasey Washington, NASA, May 1963 32 p 14 refs
(NASA TN-D-1828) OTS: $1.00

The equations-of-motion for the slideout of a vehicle equipped with a tricycle skid-type landing-gear system are presented and reduced to three degrees of freedom. A comparison of the results of numerical calculations for the three-degree-of-freedom slideout of the X-15 research vehicle with flight-test results shows that the theoretical analysis of the slideout can adequately predict the slideout distance, the direction of lateral displacement, and the approximate lateral displacement. A numerical study of the slideout equations indicates that the velocity at which the aerodynamic influence on the vehicle becomes negligible can be predicted. Author

N63-16327 North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.

FLIGHT TEST CRITERIA FOR RE-ENTERING NAP SYSTEM [Interim Report]

Air Force Special Weapons Center, Kirtland AFB, New Mex., Development Directorate, Nov. 1962 156 p 12 refs
(Contract AF 29(601)-5104)
(AFSWC-TDR-62-83)

This report covers Phase A of the Flight Test Criteria Study which will determine criteria that can be used as guidelines in setting up a flight-test program or in judging one that has been proposed. This study is intended to be universal in application to NAP reentry phenomena. The SNAP 10A was designated to provide a representative system for study. The various parameters considered and topics discussed in this report include oribtal decay and thermodynamic data, scaling, instrumentation, launch vehicles and sites, and reliability. Significant among the conclusions reached is the determination that a 300,000-foot reentry altitude can be used. Author

N63-16331 Martin Co. Nuclear Div., Baltimore, Md.

SNAP RADIOISOTOPE SPACE PROGRAMS Quarterly Progress Report No. 11, Apr. 1, 1962-June 30, 1962

[1962] 21 p 8 refs
(Contract AT(30-3)-217)
(MND-P-3019-I) OTS: $0.50

The reduction and analysis of data from two reentry heating tests on simulated SNAP fuel cores were completed. Identification of one test specimen gives support to the following significant conclusions: (1) The computational techniques used in reentry analysis are highly accurate. (2) The design theory applied to the design of SNAP flight hardware for burnup is conservative. Author

N63-16336 Martin Co. Nuclear Div., Baltimore, Md.

SNAP PROGRAMS—UPPER ATMOSPHERE EXPERIMENTAL RE-ENTRY STUDY Final Summary Report

William Hagis Apr. 1963 86 p 13 refs
(Contract AT(30-3)-217)
(MND-P-2953)

An experimental flight-test program was conducted as part of a program of safety analyses of SNAP generators designed for space use. The primary purpose of the experiment was to verify and improve the methods and techniques used to predict the aerothermodynamic effects on reentering SNAP devices. An indication of the amount of aerodynamic heating as a function of body shape, size, and mode of entry was sought. Test specimens were designed to yield trajectory, aerodynamic heating data, heat distribution, and heat transfer of known bodies. The test specimens consisted of lead bodies containing alkali metals, used as flaring material, and a larger titanium cylinder containing telemetry equipment. The lead bodies were designed to burn up at high altitudes whereas the telemetry capsule was to survive reentry. Almost complete success was experienced in obtaining optical data. There were four groups of lead bodies, each with a specific wall thickness and load and each with a characteristic alkali metal: sodium, lithium, rubidium, or cesium. All of the test specimens were photographed and positive identification was made concerning the sodium and lithium bodies. Rubidium and cesium were identified with less certainty, with the result that their correlation to specific lead bodies is considered tentative. However, this tentative correlation is corroborated by predicted results. No useful telemetry information was obtained. I.v.L.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-15779 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ORBITAL ERROR ANALYSIS OF THE SCOUT RESEARCH VEHICLE

C. H. Woodling, Jarrell R. Elliott and Paul J. Stull Washington, NASA, May 1963 53 p 1 ref
(NASA TN-D-1639) OTS: $1.50

A statistical error analysis has been made of the orbital-accuracy capability of the Scout research vehicle. Twenty-six independent error sources were included in the analysis. Orbital-altitude error bands were determined for three nominal circular orbits at altitudes of 120, 300, and 600 nautical miles. In addition, for the 300-nautical-mile mission, a detailed examination was made of the effects of the separate errors; predominant error sources were determined, and an analysis was made of the effect on the orbital accuracy of injecting into the orbit with a velocity greater than that for circular. Also, a method for determining an enclosed area in apogee–perigee space (within which approximately 95 percent of all orbits will occur) is described and applied to the 300-nautical-mile mission. The results from this analysis indicate that the 95-percent-probability or 2σ error bands for the 120-, 300-, and 600-nautical-mile nominal circular orbits have maximum variations from the nominal altitudes of approximately ± 100, ± 110, and ± 150 nautical miles, respectively. It was found that these error bands are critically dependent upon the fourth-stage tip-off error, and will be appreciably less if the present fourth-stage separation system can be shown to have a 2σ value for tip-off of less than the 3.5° assumed in this analysis. For example, for the 300-nautical-mile mission, the maximum uncertainty in orbital altitude of a 95-percent basis is reduced to ± 85 nautical miles for a 2σ value of tip-off of about 2°. The results also indicate that the overall orbital accuracy of the Scout vehicle cannot be significantly improved, exclusive of tip-off, until the rocket parameters (specific impulse, propellant weight, and propellant burning rate) can be defined to within smaller variations than those assumed for this analysis. The effect of injecting into the orbit with a velocity greater than that for circular was found to reduce considerably the uncertainties about the minimum orbital altitude (the perigee of the orbit). Author

N63-15977 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT OF THE SATURN SPACE VEHICLE

Oswald H. Lange *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 5–24 (See N63-15976 13-01)

The development of the Saturn launch vehicle concept is reviewed—from that of a vehicle using small clustered engines and ICBM-adapted hardware to that of the immense 4- or 5-stage vehicles, with F-1 clustered engines and upper stages that are capped with nuclear stages. The design and capabilities of the vehicle are presented. Also its payload and mission possibilities are outlined, and the operations of the various subsystems are described. D.E.R.

N63-15980 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE CARRIER VEHICLE FIRING HISTORIES

Frederick I. Ordway III *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 63–93 (See N63-15976 13-01)

Rocket-propelled vehicles designed to place payloads either: (1) in orbit around the earth, (2) along escape trajectories, or (3) to vertical altitudes of at least 300 miles are discussed and the firing histories of the various vehicles are given in tabular form. D.E.R.

N63-15984 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

HISTORY OF THE CLUSTER SYSTEM

William H. Pickering *In* NASA. Marshall Space Flight Center, Huntsville, Ala. From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 141–154 (See N63-15976 13-01)

The use of clustered solid propellant rockets for the high-speed stages of a satellite carrier vehicle was first proposed by Dr. von Braun in 1954. After a JPL feasibility study of the proposal, a configuration using a modified Redstone missile as the first stage and clusters of scaled-down Sergeant motors for the second and third stages was approved. In September 1955, the vehicle was designated Jupiter C and incorporated in the reentry test vehicle (RTV) program. By August 1956, four test firings of the Jupiter C had demonstrated the capabilities of clustered engines, proved the ablative protection technique, and resulted in the recovery of a reentry nose cone. Subsequently, the same Jupiter C with an added fourth stage motor and payload was designated Juno 1 and used to launch Explorer I, the first U.S. satellite, in January 1958. Explorers 3 and 4 were also launched by Juno 1. Juno 2, incorporating the same clustered high-speed stages but substituting a Jupiter ICBM for the Redstone missile first stage, successfully launched Explorers 7, 8, and 11. M.P.G.

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-15873 National Weather Satellite Center, Washington, D.C.

CATALOGUE OF TIROS V CLOUD PHOTOGRAPHY FOR JULY 1962 (PASSES 168 THRU 601)

Sept. 1962 49 p

The second part of a series of television cloud photographs obtained by the Tiros V meteorological satellite during July 1962 is presented. The picture frames are presented with the proper annotations as to pass time, date, and geographical area covered. A series of maps provides a rough indication of the area covered by each sequence having usable frames and for which picture taking time has been analyzed. J.A.J.

N63-15931 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

FRICTION MEASUREMENTS ON A LOW EARTH SATELLITE

J. B. Rittenhouse, L. D. Jaffe, R. G. Nagler, and H. E. Martens Apr. 15, 1963 46 p 16 refs

(NASA Contract NAS7-100)

(JPL-TR-32-402) OTS: $4.60 ph, $1.58 mf

The coefficient of sliding friction for a number of materials was measured during the flight of the Ranger 1 spacecraft. Flat disks of materials of interest were rotated at a speed of 8 to 14 in./min while in contact with 1/8-in.-D hemispherical riders. Because of the low orbit achieved by Ranger 1, the experiment was exposed to vacuum in the range of 3×10^{-6} to 8×10^{-9} mm Hg. For unlubricated metals sliding on metals, the friction coefficient averaged about 0.5; for some combinations of metals, it occasionally exceeded 1.0. Lower values were observed with lubricants of grease or gold-plate, and for ceramics sliding against metals. The coefficient of friction was very low, averaging 0.04, for metallic pairs lubricated with molybdenum disulfide and for polytetrafluoroethylene sliding against metals and ceramics. Relatively low friction coefficients were found for metallic materials sliding against unlubricated metallic and ceramic materials when at least one member of the pair was of high hardness. The coefficients observed for unlubricated metal pairs were not inconsistent with the hypothesis that high friction tends to correlate with high mutual solid solubility. In general, the coefficients in space and in a laboratory vacuum of 5×10^{-6} mm Hg were not systematically different. For unlubricated metallic materials, friction in vacuum was higher than in air at shorter running times. Author

N63-15985 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EXPLORER SATELLITES LAUNCHED BY JUNO 1 AND JUNO 2 VEHICLES

J. Boehm, H. J. Fichtner, and Otto A. Hoberg *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 163–202 18 refs (See N63-15976 13-01)

The evolution of the Explorer series of satellites which were launched by Juno 1 (25-lb maximum payload capability) and Juno 2 (92-lb maximum payload capability) is described. The mechanical layout of the satellites was influenced by the low payload capability and the spin applied to the upper stages which required lightweight structure, miniaturized components, and design symmetry. The dynamics involved in maintaining satellite orientation are considered, and the problems encountered in instrumentation, tracking, design, and systems engineering are described. The power supply systems and electrical and timing networks are discussed with particular emphasis on solar-cell battery-power supply systems. Finally, the test program which contributed to the reliability necessary for satellite missions is described. M.P.G.

N63-15986 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

CORRELATION OF THE THERMAL BEHAVIOR OF SATELLITES AND THE ROTATIONAL MOMENTUM VECTOR

Gerhard B. Heller, Billy P. Jones, Robert J. Naumann, and William C. Snoddy *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 203–240 (See N63-15976 13-01)

The method of passive thermal control developed for the series of Explorer satellites is described. The temperature onboard a satellite was found to be determined by three groups of variables: (1) satellite environment, (2) satellite configuration, and (3) thermal properties of satellite materials. Data from the earlier Explorers showed that the rotation spin mode and attitude of the satellite could be determined from satellite temperatures. Methods also were developed to determine the rotational characteristics of the Explorer satellites from radio-signal strength measurements.
M.P.G.

N63-16010 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SCIENTIFIC RESULTS FROM JUNO-LAUNCHED SPACECRAFT
Charles A. Lundquist, Arthur W. Thompson, and Ray V. Hembree *In its* From Peenemünde to Outer Space. [A Volume of Papers] Commemorating the Fiftieth Birthday of Wernher Von Braun Mar. 23, 1962 p 749–768 75 refs (See N63-15976 13-01)

The scientific results from Juno-launched spacecraft (the Explorer series through Explorer 11, and Pioneer 4) are discussed. Since these were among the earliest satellites launched, their instruments produced several significant discoveries concerning energetic charged particles, thermal environment within the satellite, thermal radiation balance of the earth, micrometeorites, properties of the ionized particles in the ionosphere, and cosmic gamma rays. Auxiliary investigations, using observations of these satellites, included orbit theory and determination, motion about the center of mass, atmospheric density, and ionospheric radio propagation studies. In addition, these satellites contributed to space engineering knowledge, and promoted international cooperation. M.P.G.

N63-16024 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
METHODS OF METEOROLOGICAL INVESTIGATION BY MEANS OF SATELLITES (METODY METEOROLOGICHESKIKH ISSLEDOVANII S POMOSHCHIYU SPUTNIKOV)
K. Ya. Kondratiev London, Ministry of Aviation, Feb. 1963 20 p 39 refs Chap. 3 of the book "Meteorologicheskie Issledovaniya s Pomoshchiyu Raket i Sputnikov", Leningrad, GIMIZ, 1962 Translated into ENGLISH
(RAE-TRANS-1027)

This paper, which consists of a part of Chapter III of Kondratiev's book *Meteorological Investigations by Means of Rockets and Satellites*, reviews the methods for determining upper-atmosphere density from the changes in satellite orbits and from instruments carried on satellites, and discusses some of the results obtained by investigations in Russia and elsewhere. Author

N63-16171 RAND Corp., Santa Monica, Calif.
RADIATION ENVIRONMENT FOR MANNED SPACECRAFT
S. H. Dole Apr. 18, 1963 8 p 4 refs Presented at Inst. of Environmental Science, Los Angeles, Apr. 18, 1963
(P-2691)

Van Allen belts, electromagnetic radiation, solar flare protons, and galactic cosmic particles are discussed in relationship to the danger they present to man in space. Low earth orbits, high earth orbits, lunar missions, and interplanetary missions are discussed in relation to radiation environment. Flare shelters for the crew are necessary for long interplanetary missions as the probability that large solar flares will occur increases as the length of the mission increases. J.A.J.

N63-16247 Armed Services Technical Information Agency, Arlington, Va.
SCIENTIFIC SATELLITES Report Bibliography
Sara Bjorge, comp. Dec. 1962 29 p 120 refs Prepared for the American Astronautical Soc. Scientific Satellite Symp., Dec. 27, 1962
(AD-290800)

This is a bibliography which covers the design and instrumentation of scientific satellites, properties of the ionosphere derived from satellite research, and meteorological satellites.
Author

N63-16268 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FEASIBILITY STUDY OF SOLAR PROBES
C. F. Hall, G. J. Nothwang, and H. Hornby [1962] 16 p 7 refs Presented at the IAS 30th Annual Meeting, New York, Jan. 22–24, 1962
(IAS Paper-62-21) IAS: $0.50 members, $1.00 nonmembers

Results are presented from a study of a space mission which has received relatively little attention as yet—that of exploration near the sun using instrumented probes. Three instrument payloads were selected for study, ranging from that required to make only a few measurements of highest priority to that necessary to make a wide variety of measurements over relatively wide ranges. Booster, communication, and on-board power systems are also examined from points of view of present state-of-art as well as future potential. Other areas discussed relate to thermal protection of the instruments and controlling the attitude of the probe. The results show that, with present techniques, it is possible for a solar probe with scientific instruments weighing up to 74 pounds to be launched in an orbit approaching the sun within 0.3 AU in the 1964–1965 era. The booster is one having the performance of an Atlas Centaur with an additional solid-propellant upper stage. The thermal-protection system maintains the capsule temperature nearly constant. In 1966, and thereafter, it will be possible to place a probe having 16 pounds of scientific instruments within 0.05 AU of the sun. The booster will be one having the performance of a Saturn C-1 with additional H_2-F_2 upper stages. The concept for thermal protection is the same as that for the previous probe. Communication with both probes is maintained up to the maximum distance between the probe and earth, 2 AU. Author

N63-16295 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF SEVERAL FACTORS AFFECTING THE FLUTTER CHARACTERISTICS CALCULATED FOR TWO SWEPT WINGS BY PISTON THEORY AND BY QUASI-STEADY SECOND-ORDER THEORY AND COMPARISON WITH EXPERIMENTS
Robert M. Bennett and E. Carson Yates, Jr. Washington, NASA, May 1963 42 p 16 refs
(NASA TN-D-1794) OTS: $1.25

Flutter characteristics of two homogeneous untapered wings, one having 15° sweep and aspect ratio 5.34 and the other having 30° sweep and aspect ratio 4.16, have been investigated analytically for Mach numbers up to 3.0. Calculations included variations in number and type of vibration modes employed (that is, measured natural modes or uncoupled beam-type modes) and in the treatment of finite wing thickness and of loading in the tip region.
Author

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-15765 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHODS OF EXPRESSING MASS UNBALANCE
N. C. Schaller and J. M. Lewallen Washington, NASA, May 1963 12 p
(NASA TN-D-1446) OTS: $0.50

Three different methods of expressing mass unbalance are presented: (1) force vectors in two planes perpendicular to the axis, (2) principal axis shift and tilt, and (3) force and moment vectors relative to the center of gravity. Each method is discussed briefly. However, method (3) has been determined to be the more useful in expressing mass unbalance for spacecraft payloads, because: (a) specific payload data, other than center of gravity location are not required, (b) static unbalance is separated from dynamic unbalance, and (c) convenient comparison to other payload configurations is possible. Since unbalance information is conventionally recorded in two planes perpendicular to the spin axis, a unique conversion operation is presented which allows method (1) to be expressed as method (3). Author

N63-15777 National Aeronautics and Space Administration, Washington, D. C.
A CONTRIBUTION TO THE THEORY OF PRESSURE STABILIZED STRUCTURES
A. C. Kyser (Astro Research Corp., Santa Barbara, Calif.) May 1963 42 p 3 refs
(NASA Contract NASr-8)
(NASA TN-D-1919) OTS: $1.25

A large-deformation analysis is presented for an element of a flexible inflatable plate consisting of an array of contiguous tubes. The element is represented by a transversely loaded, pressurized, cylindrical chamber of indefinite length having two flat sides connected by flexible but inextensible membranes. The behavior of the cylindrical element is described for the complete range of deformation for the case of lateral compression, shear, or rolling loads, and a method is described for obtaining a graphical solution for the shape of the cross section under any given combination of loads. It was found that, under certain conditions, large compressive deformations give rise to geometrical instabilities, or conditions of negative spring rate. Author

N63-15795 Allied Research Associates, Inc., Boston, Mass.
PLASTIC STABILITY THEORY OF GEOMETRICALLY ORTHOTROPIC PLATES AND CYLINDRICAL SHELLS
George Gerard 1962 7 p 9 refs Repr. from J. Aerospace Sci., v. 29, no. 8, Aug. 1962 p 956-962
(NASA Grant NsG-17-59)

A linear eighth-order equilibrium differential equation for plastic buckling of geometrically orthotropic, thin cylindrical shells is derived. This equation is used to obtain explicit solutions for long, flat plates and wide columns under axial compression, and moderate-length cylinders under external pressure, torsion, and axial compression. Author

N63-15806 Brown U. Metals Research Lab., Providence, R.I.
ULTRASONIC METHODS IN THE STUDY OF FATIGUE AND DEFORMATION IN SINGLE CRYSTALS OF ALUMINUM AND SODIUM CHLORIDE [Final Report, Dec. 1960-Dec. 1961]
Bruck Chick, Akira Hikata, George Anderson, William Findley, Charles Elbaum, and Rohn Truell Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 37 p 6 refs
(Contract AF 33(616)-6945)
(ASD-TDR-62-186)

The use of ultrasonic methods for studying defect formation and its consequences in connection with stress cycling and deformation in aluminum and sodium chloride single crystals is the subject of this report. The observed ultrasonic changes appeared closely associated with changes in dislocation behavior. To establish this, deformation experiments were used in such a way that results could be related to the behavior of the slip systems and to their orientation. Aluminum single crystals were used for these experiments. Simultaneous measurements of attenuation and velocity changes were made continuously during tensile deformation. In the very early stages of deformation, for all orientations, an increase in attenuation is observed before microscopic yield. Easy glide is observed by the attenuation and velocity changes. Measurements in tension have been made for the purpose of comparing the dislocation damping and pinning effects in an ionic crystal with those in a metal. Important equipment improvements have been made for automatic recording of attenuation and velocity measurements. Author

N63-15827 Minnesota U., Minneapolis
STATISTICAL RESPONSE OF A BAR IN TENSION [Final Report, July 1959-Sept. 1961]
D. A. Smith, T. I. Smits and R. F. Lambert Wright-Patterson AFB, Ohio, Directorate of Materials and Processes Apr. 1962 44 p 19 refs
(Contract AF 33(657)-7453)
(ASD-TDR-62-379)

Theoretical and experimental statistical analysis of the random response of a continuous bar in tension is presented. Particular attention has been paid to the probability distribution of the strain response which, for a linear second-order system under gaussian excitation, follows a Rayleigh distribution. However, when the excitation level of the clamped-clamped continuous bar is sufficiently high so that the tensile strain becomes comparable with the bending strain, then the strain crest distribution no longer follows the Rayleigh prediction. At high strain levels, the distribution of positive crests as well as maxima is greater than the Rayleigh prediction, and the distribution of negative crests as well as minima is less. The distribution of positive maxima falls below the positive crest distribution as the Q of the system decreases. Similarly, the distribution of negative minima falls below the negative crest distribution as the Q decreases. Author

N63-15839 Northrop Corp. Norair Div., Hawthorne, Calif.
FATIGUE TESTING OF HONEYCOMB SANDWICH CONSTRUCTION [Final Report, May 1960-May 1961]
H. Spector Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1962 64 p 5 refs
(Contract AF 33(616)-7200)
(ASD-TDR-61-338)

Dynamic methods, developed by Northrop Corporation, Norair Division for determination of Young's modulus for honeycomb sandwich constructions, were successfully applied to obtain honeycomb core-fatigue properties. S–N curves for extensional core fatigue were developed for representative samples of brazed, welded, and adhesive-bonded honeycomb constructions. For tension-compression, the data show that core density is a dominant parameter in core fatigue. There are indications that core thickness up to and including 1 inch has little effect upon the data; more investigation is necessary to determine the effect of thickness greater than 1 inch. Feasibility of obtaining core fatigue using a two-specimen shear-modulus approach was demonstrated, but more development is necessary in the design of testing systems to obtain dynamic balance and proper load levels. Author

N63-15879 Bolt Beranek and Newman, Inc., Cambridge, Mass.
STUDY OF A RESPONSE LOAD RECORDER
P. W. Smith, Jr., E. A. Starr, C. W. Dietrich, and D. U. Noiseux Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 118 p 28 refs
(Contract AF 33(616)-7789)
(ASD-TDR-62-165, Vol. II)

A compact instrument to measure the strain history of a point on a resonant structure of a flight vehicle is considered. The output data from the instrument is designed to aid in the estimation of acoustic fatigue damage. The ability of a strain gage to perform under fatigue conditions is examined. The design of circuitry to modify the sonic recorder to a response recorder is discussed. Performance data of the breadboarded response recorder, tested with a resonant structure, are given. Author

N63-15912 Chance Vought Corp. Aeronautics and Missiles Div., Dallas, Tex.

RESEARCH TO DETERMINE LOW CYCLE FATIGUE DESIGN DATA ON MATERIALS IN A MULTI-AXIAL STRESS FIELD First Progress Report, Apr. 1, through June 30, 1962

S. W. Claren III and J. J. Peterson June 30, 1962 58 p
(Contract AF 33(657)-8525)
(CVC-2-53420/2R400)

Program aim is to determine the effects of a multiaxial stress field on the fatigue life of Ti-6Al-5V alloy, 301 stainless steel, and AM-355 stainless steel. A summary of the work accomplished thus far is as follows: (1) The adminstrative and operational procedures for controlling the program were established. (2) Process control schedules, heat treatment procedures, and welding methods were outlined. (3) Required tooling and jig work were accomplished. (4) The mandrel for the hydrospinning operation was completed. (5) Welding fixtures needed in performing the circumferential welds on the pressure vessels are ready for use. (6) Hydro-spinning of the 301 stainless steel was initiated. (7) The work required to fabricating a ring test fixture has been completed. Trial test rings to prove out this fixture have been fabricated. One trial ring has been successfully tested in this fixture. (8) The basic approach to data analysis and presentation have been established and are outlined. I.v.L.

N63-15913 Chance Vought Corp. Aeronautics and Missiles Div., Dallas, Tex.

RESEARCH TO DETERMINE LOW CYCLE FATIGUE DESIGN DATA ON MATERIALS IN A MULTI-AXIAL STRESS FIELD Second Progress Report, July 1 through Sept. 30, 1962

S. W. Mc Claren III and J. J. Peterson Sept. 30, 1962 53 p
(Contract AF 33(657)-8525)
(CVC-2-53420/3R411)

Cold drawing and shear spinning processes are described for 301 and AM-355 stainless steels and 6Al-4V titanium alloy; and the effects of these processes on the strength of these alloys is being investigated. The ring test fixture proved to be unsatisfactory for static testing ring specimens cut from pressure vessels made of 301 stainless steel, so standard tensile tests performed in both grain directions were substituted. The results indicate the work-hardened strength of these materials without large amounts of residual stresses. The objective of these tests is to generate biaxial fatigue data for analysis of multiaxial stress. M.P.G.

N63-15914 Chance Vought Corp. Aeronautics and Missile Div., Dallas, Tex.

RESEARCH TO DETERMINE LOW CYCLE FATIGUE DESIGN DATA ON MATERIALS IN A MULTI-AXIAL STRESS FIELD Third Progress Report, Oct. 1, through Dec. 31, 1962

S. W. McClaren III and J. J. Peterson Dec. 31, 1962 53 p
(Contract AF33 (657)-8525)
(CVC-2-53420/3R436)

Low-cycle fatigue data for 301 and AM-355 stainless steels and a 6Al-4V titanium alloy are presented. Results are reported for uniaxial static and fatigue tests, pressure vessel static and fatigue tests, and biaxial static and fatigue tests. The effects of various stress states and processing variables are being correlated with actual pressure vessel tests in an attempt to develop procedures for analyzing multiaxial stress from biaxial stress data. M.P.G.

N63-15932 California Inst. of Tech. Graduate Aeronautical Labs., Pasadena

STUDIES IN GRANULAR MECHANICS—I

P. J. Blatz Jan. 1963 8 p
(NASA Grant NsG-172-60, Suppl. 1-62)
(GALCIT-120; GALCIT SM-63-2) OTS: $1.10 ph, $0.80 mf

A mathematical model for the elastic behavior of a non-adhesive rubber binder highly filled with rigid spherical inclusions is presented. The maximum volume fraction for hexagonal close-packed spheres is used and the assumption is made that, when the specimen is stretched in simple tension by a factor λ, the binder pulls away from each granule, opening up a hole on either side and forming a cavity of the shape of a double-cone. By applying conservation of volume equations and then relating the actual stretch state of the binder to the macroscopic stretch state, a model is derived for determining the lateral contraction ratio as a function of λ. M.P.G.

N63-15934 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

PROBLEMS ASSOCIATED WITH HIGH-TEMPERATURE FASTENERS

J. C. Blake, H. J. Kurtz, and R. L. Sundin Apr. 15, 1963 29 p 2 refs
(Contract AT(40-1)-2847)
(GEMP-186) OTS: $0.75

This report gives stress relaxation data for Inconel X bolts and nuts at 700°, 900°, and 1100° F for periods of time up to 500 hours. Also covered in detail are the unresolved problems associated with the application of high-temperature fasteners to nuclear reactors or other critical types of mechanisms where high reliability is required. Author

N63-15961 Ohio State U. Research Foundation, Columbus

ASPECTS OF RELIABILITY UNDER CONDITIONS OF ELEVATED TEMPERATURE CREEP AND FATIGUE [Summary Report, Feb. 1-Oct. 1, 1962]

A. M. Freudenthal Wright-Patterson AFB, Ohio. Directorate of Materials and Processes, Mar. 1963 45 p 12 refs
(Contract AF 33(616)-6288)
(ASD-TDR-63-267)

The solution of the problem of attaining adequate safety and reliability in supersonic aircraft structures, operating under the conditions that the damaging effects of cycle sensitivity (fatigue) and time-sensitivity (creep) of the structural material combine in gradually reducing the resistance of the structure, requires the development of simplified procedures for the evaluation of the combined damage accumulation. These procedures embody both the physical and probabilistic aspects of design. This report attempts to develop the basis for an approach to the solution of this problem, and provides the guidelines for the planning of tests and experiments, the results of which would be relevant for structural design. Author

N63-15968 Polytechnic Inst. of Brooklyn, N.Y.

CIRCULAR CYLINDRICAL SHELLS UNDER SEGMENTAL CIRCUMFERENTIAL LINE LOAD

James Sheng (Ph. D. Thesis–1956) and Joseph Kempner Apr. 1963 61 p 34 refs
(Contract Nonr-839(17))
(PIBAL-663)

Equations for the deflections of and the stresses in thin-walled circular, cylindrical shells, simply supported at their ends and under segmental circumferential line-loads, are determined. These loads consist of a uniformly distributed segmental radial load yielding a resultant radial force at the midpoint of a generator, a piecewise, uniformly distributed radial load statically equivalent to a concentrated circumferential moment at the midpoint of a generator, and a uniformly distributed longitudinal moment statically equivalent to a concentrated axial moment applied at the midpoint of a generator. Practical applications of the solutions given are indicated for solutions of problems involving loadings other than those specifically treated. Comparison is made of the solutions of this radial line-load case with those corresponding to a line load along a segment of a generator of a corresponding cylinder. The numerical

results, considered in the light of earlier solutions, show that the present solutions are adequate for the direct estimation of deflections and membrane stresses due to localized surface loads. Author

N63-16076 Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C.

[PAPERS FROM] 31ST SYMPOSIUM ON SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS—PART III, PHOENIX, ARIZONA, OCTOBER 1-4, 1962

W. H. Mutch Apr. 1963 340 p 96 refs

(Supported by the Air Force)

(Bulletin No. 31)

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22. ACOUSTIC AND VIBRATION STANDARD ENVIRONMENTAL DATA ACQUISITION PROCEDURES R. W. Peverley (Martin Co.) p 254–260 5 refs (See N63-16096 13-15)

ENVIRONMENTAL PROGRAMS

23. DATA EXCHANGE PROGRAMS CONDUCTED BY U.S. NAVAL ORDNANCE LABORATORY, CORONA, CALIFORNIA S. Pollock (NOL) p 261–275 (See N63-16097 13-17)
24. INFORMATION ON DATA EXCHANGE PROGRAM—ENVANAL R. E. Engelhardt (Southwest Res. Inst.) p 276–277 2 refs (See N63-16098 13-01)
25. THE ARMY QUARTERMASTER CORPS PROJECTS COVERING THE ANALYSIS AND EVALUATION OF ENVIRONMENTAL FACTORS W. B. Brierly (Quartermaster Res. and Eng. Labs.) p 278–300 22 refs (See N63-16099 13-01)

N63-16077 Northrop Corp. Norair Div., Hawthorne, Calif.

UTILIZATION OF DYNAMICALLY SIMILAR STRUCTURAL MODELS IN PREDICTING VIBRATION RESPONSES OF FLIGHT VEHICLES

K. M. Eldred, R. W. White (Western Electro-Acoustic Lab.), and W. H. Roberts *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 1–11 3 refs (See N63-16076 13-33)

This paper describes the results to date of two programs which are directed toward the development of the dynamically similar structural model for the prediction of vibration and strain responses of the full-scale vehicle. Results are given from a completed preliminary program which determined the response of simple scaled panels to scaled jet noise. A brief progress report is given of the current program which compares the acoustic vibration transfer functions of a 1/4-scale model of a 377-inch segment of the Snark fuselage with full-scale data. Full-scale data, leading toward an improved understanding of the transmission and acceptance of vibratory energy in a complex structure, are discussed. Author

N63-16078 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

ESTIMATION OF SOUND-INDUCED VIBRATIONS BY ENERGY METHODS, WITH APPLICATIONS TO THE TITAN MISSILE

Peter A. Franken and Richard H. Lyon *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 12–26 7 refs (See N63-16076 13-33)

(Supported by Space Tech. Labs., Inc.)

This paper presents a first step in a new approach to the estimation of acoustically induced vibration of complicated vehicles. Although the results of this study are restricted to the estimation of vehicle skin-panel motion, the general concepts involved can be extended to the study of vibration transmission to internal structures. Author

N63-16080 Lockheed Missiles and Space Co., Sunnyvale, Calif.

RANDOM FATIGUE DATA

R. E. Bieber and J. H. Fairman *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 32–38 (See N63-16076 13-33)

A test program is described for obtaining fatigue data applicable to the design of structures subjected to random vibration loading. The motivation and test philosophy is discussed. Small cantilever beams subjected to "band-limited white noise" base excitation were tested. The instrumentation used to measure the vibration response consisted of a commercially-available optical-displacement tracking device. The estimated bending-strain response computed from the measured displacement of the free end of the cantilever is compared with a direct strain measurement. The agreement is found to be good. It is concluded that the optical instrumentation combined with analog-to-digital data processing provides a workable means of accurately and economically obtaining the large amounts of response data required in a random vibration fatigue test. Author

N63-16081 American Machine and Foundry, Stamford, Conn.

A GENERALIZED RESPONSE EVALUATION PROCEDURE FOR MULTIDEGREE SPRING MASS SYSTEMS

A. B. Burns *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 39–54 7 refs This paper was not presented at Symp. (See N63-16076 13-33)

This paper outlines, in generalized language, a procedure for evaluating the response of linear multidegree-of-freedom spring mass systems to shock and to other forms of disturbances as well. The novel feature is a concise summary of the relations which permit the responses of multidegree systems to be defined in terms of the responses of corresponding single-degree systems. Such responses are typically reported by shock spectra. The concept of effective modal mass also is treated. Author

N63-16082 Hughes Aircraft Co. Space Systems Div., Culver City, Calif.

RESPONSE OF LIGHTLY DAMPED STRUCTURES TO RANDOM PRESSURE FIELD

H. Serbin *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 55–62 7 refs This paper was not presented at Symp. (See N63-16076 13-33)

A completely rational design of structures subjected to random loads is possible only when adequate information is available on the forcing input and on the behavior of materials to random stresses. When this information is not available, one must depend on semi-empirical methods of analyzing structural response. To facilitate this procedure, existing theory on the response of a multi-degree-of-freedom system is extended to the case where all the generalized forces are random. The result is simplified when the forcing function is due to small-scale turbulence. The theory is illustrated in the case of a simply supported beam. Author

N63-16083 Boeing Co., Seattle, Wash.

SPATIAL CORRELATION IN ACOUSTIC-STRUCTURAL COUPLING AND ITS EFFECT ON STRUCTURAL RESPONSE PREDICTION TECHNIQUES

D. J. Bozich *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 63–79 5 refs This paper was not presented at Symp. (See N63-16076 13-33)

The responses of flat rectangular panels, with simply-supported or clamped boundary conditions, to specified acoustic fields are examined analytically and numerically to improve response-prediction techniques for practical problems. Analytical development for beam-like structures, found in the literature, was modified and extended to rectangular panels. The prediction of panel response can be accomplished with knowledge of the power spectrum and spatial correlation of the acoustic field and the panel mechanical impedance. Numerical results of the acoustic-structural-coupling-coefficient frequency spectrum indicate a marked sensitivity to changes in the spatial correlation, a measure of the coherence of the force distribution over the panel. Consequently, as the spatial correlation decreases, the panel mode shapes lose their wavelength selectivity and, hence, respond at all frequencies. The analytical work is of value in its ability to define numerical limits on the response of panels with specified boundary conditions to acoustic plane-wave fields with various degrees of spatial correlation. Extrapolation to practical problems can result in a better estimation of the order of magnitude of the expected response. Author

N63-16085 Boeing Co. Aero-Space Div., Seattle, Wash.

PRACTICAL RANDOM VIBRATION MEASUREMENT TECHNIQUES

Wilbur F. Du Bois *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 111–126 (See N63-16076 13-33)

A random vibration environment is applied to a test specimen and the resulting data examined. The power-spectral-density analyzer is described and its use explained. Some pretest checks, which are required to insure reliable data, are described. Author

N63-16086 Sandia Corp., Albuquerque, N. Mex.

PHASE MEASUREMENT IN VIBRATION TESTING

Walter B. Murfin *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 127–133 (See N63-16076 13-33)

Practical methods are given for using the complex response and complex impedance in solving several problems. Methods of recording complex response and impedance are given, as well as several curves of the sort of transfer functions to be expected. Rapid and practical computer use of complex response is also illustrated. Author

N63-16091 Thompson Ramo Wooldridge, Inc. Ramo-Wooldridge Div., Canoga Park, Calif.

EXPERIMENTAL VERIFICATION OF VIBRATION CHARACTERISTICS USING STATISTICAL TECHNIQUES

A. G. Piersol and L. D. Enochson *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration, and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 195–210 3 refs (See N63-16076 13-33)

(Contracts AF 33(616)-7434 and AF 33(657)-7459)

This paper discusses the application of statistical techniques to the analysis and interpretation of vibration data. Emphasis is

placed on application of vibration measurements as estimators for future vibration environments. Theoretical considerations are presented which are supported by actual experimental results. Author

N63-16092 Autonetics, Downey, Calif.
TECHNIQUES OF ANALYSIS OF RANDOM AND COMBINED RANDOM-SINUSOIDAL VIBRATION
Ivan J. Sandler *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 211–224 2 refs This paper not presented at Symp. (See N63-16076 13-33)

This paper discusses the conversion from a voltage-frequency to a power-spectral-density curve; the determination of composite random acceleration level from a voltage-frequency curve; and determination of total rms acceleration of a sine + random-vibration test from a voltage-frequency curve. Author

N63-16093 Boeing Co., Seattle, Wash.
THE APPLICATION OF DIGITAL ACQUISITION TECHNIQUES TO THE ANALYSIS OF SHOCK AND VIBRATION DATA
John W. Yerkes *In* Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1–4, 1962 Apr. 1963 p 225–231 4 refs This paper was not presented at Symp. (See N63-16076 13-33)

The analysis of shock and vibration data is becoming more and more difficult as tests become complex and space payloads require lighter and more efficient structures. This paper describes the evolution of a new, inexpensive, digital-data system to help automate the laboratory and solve the more difficult problems. A unique multiplexing technique allows the sampling of many channels of 2000-cps data. Author

N63-16238 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, Va.
FACTORS AFFECTING LOADS AT HYPERSONIC SPEEDS
Arthur Henderson, Jr., and Mitchel H. Bertram Washington, NACA, June 19, 1957 23 p 19 refs
(NACA-RM-L57D25a) OTS: $2.60 ph, $0.89 mf (Declassified)

This paper gives a brief summary of current loads information at hypersonic speeds. Several methods which the designer can employ in estimating the loads on various aircraft components are discussed. The paper deals with the characteristics of both slender and blunt configurations, and touches upon the effects of boundary-layer and aerodynamic interference. Author

N63-16239 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, Va.
LOADS DUE TO CONTROLS AT TRANSONIC AND LOW SUPERSONIC SPEEDS
F. E. West, Jr., and K. R. Czarnecki Washington, NACA, June 7, 1957 15 p 11 refs
(NACA-RM-L57D26a) OTS: $1.60 ph, $0.80 mf (Declassified)

Some results of recent experimental investigations at supersonic and transonic speeds are presented to show the present status in the estimation of load distributions on controls and adjacent wing surfaces resulting from the deflection of flap controls and spoiler controls. The results indicate that the development of methods for predicting loads associated with controls has not kept pace with the acquisition of experimental data. At low supersonic speeds, sweeping the hinge line induces strong three-dimensional-flow characteristics which cannot be treated by the simplified methods previously developed for controls without sweep. At transonic speeds, the estimation of loads associated with controls must usually be dependent upon experimental information. Author

N63-16240 National Advisory Committee for Aeronautics Langley Aeronautical Lab., Langley Field, Va.
CALCULATION OF EXTERNAL-STORE LOADS AND CORRELATION WITH EXPERIMENT
Percy J. Bobbitt, Harry W. Carlson, and Albin O. Pearson Washington, NACA, July 29, 1957 21 p 32 refs
(NACA-RM-L57D30a) OTS: $2.60 ph, $0.83 mf (Declassified)

A theory for evaluating the mutual interference between a wing and tip tank has been extended to apply to store-pylon configurations. By use of this analysis and the flow-field formulas of NACA Research Memorandum L55L30b and NACA Technical Note 3938, theoretical store-pylon side-force estimates have been made for a number of store-pylon configurations. Comparisons of the theoretical estimates with experimental results obtained at the Langley Aeronautical Laboratory indicate that theory is capable of predicting satisfactorily a variety of effects. Considered in this paper are the separate effects of spanwise store position, chordwise store position, angle of sideslip, store fins, store-store interference, and fuselage indentation. The experimental data and theory indicate that the pylon and pylon-induced side forces are the largest contributors to the total store-pylon side force. A short bibliography of NACA publications dealing with store and missile loads is included. Author

N63-16244 Brown U. Div. of Applied Mathematics, Providence, R.I.
A SPHERICAL SHELL UNDER POINT LOADS AT ITS POLES Technical Report
W. T. Koiter Feb. 1962 24 p 8 refs
(Contract Nonr-562(10))
(C11-75)

A rigorous solution in closed form is obtained of the equations of the linear theory of shells for the case of a spherical shell under point loads at its poles. The solution reduces to a membrane state of stress at some distance from the poles. In the immediate vicinity of the poles, E. Reissner's results for a shallow spherical shell under a point load at its apex are confirmed; the discrepancies remain within the limits of accuracy of shell theory. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-15778 National Aeronautics and Space Administration, Washington, D.C.
ANALYSIS OF AXISYMMETRIC, ROTATING PRESSURIZED FILAMENTARY STRUCTURES
O. R. Burggraf and H. U. Schuerch (Astro Research Corp., Santa Barbara, Calif.) May 1963 47 p 9 refs
(NASA Contract NASr-8)
(NASA TN-D-1920) OTS: $1.25

An analytic treatment of the equilibrium configurations for thin-walled, axisymmetric, rotating, filamentary pressure vessels is presented. Solutions in the form of tabulated elliptical integral functions are developed for the pertinent geometrical characteristics of the structural shapes and for their associated filamentary geometries. A morphological review of the corresponding structures is presented, based upon a discussion of the mathematical properties of the solutions. Experimental realization of the equilibrium configuration of a single filament subject to a centrifugal force field confirms the validity of analytic expressions. Applications

of formulas to problems of external loadings and of the static stability of filamentary, pressure-stabilized structures demonstrate the utility of the analytical technique. Author

N63-15860 Lockheed-California Co. Spacecraft Organization, Burbank, Calif.
STUDY OF EXPANDABLE STRUCTURES [Second] Progress Report (Covering period Oct. 15, 1962 to Feb. 15, 1963)
Feb. 25, 1963 33 p 45 refs
(Contract AF 33(657)-8776)
(LR-16654)

This second report includes: (1) applicable expandable structures information obtained by visits to forty-five companies or organizations, (2) the methods used to analyze the literature, concepts, design, and structural criteria, (3) statements of the format and content of the Expandable Structures Handbook and the Summary Technical Report (final report), and (4) work presently in progress and scheduled future work. Author

N63-16028 General Dynamics/Astronautics, San Diego, Calif.
STUDY OF PRINCIPLES OF METEOROID PROTECTION Final Report
R. F. Rolsten, H. H. Hunt, and J. N. Wellnitz Apr. 1962 212 p 72 refs
(NASA Contract NAS8-875)
(AE62-0413) OTS: $14.50 ph, $6.56 mf

The hypervelocity impact data related to meteoroid bumper protection systems for aerospace vehicles can be summarized as follows: (1) One hundred and forty-two impact experiments were made with the explosive driver accelerator and eight with the light gas gun. (2) Impact data were obtained with 0.1875-, 0.125-, 0.090-, 0.063-, and 0.032-inch aluminum (6061-T6) bumpers. (3) Bumpers other than aluminum were: (a) plate glass; (b) wire screen; (c) magnesium–lithium alloy; and (d) 301 stainless steel. (4) Structures pressurized with water, air, liquid, and gaseous oxygen are discussed. (5) The preliminary results of the protection efficiency of energy-absorbing core materials are given. (6) Projectile mass was 0.57, 0.34, 0.21, 0.12, and 0.097 gram for steel; 0.67 gram for copper; 0.08 gram for glass; and 0.299 gram for nylon. (7) Projectiles were accelerated in air and vacuum, with and without premature fragmentation, to velocities in the range from 10,000 to 28,600 ft/sec. (8) Preliminary data relating the shear-plug diameter to plate thickness of several materials are given. (9) Photographic coverage of the impact phenomena was obtained. (10) A summary and discussion of the results observed in this program are given. (11) The principles of meteoroid protection are delineated. (12) Literature data pertinent to the phenomena associated with hypervelocity impact of relatively thin plates are summarized in the Appendix. Author

N63-16046 Armour Research Foundation, Chicago, Ill.
LINER FOR EXTRUSION BILLET CONTAINERS, PHASE I Interim Technical Documentary Progress Report, June 5, 1962-Dec. 5, 1962
S. A. Spachner Dec. 1962 78 p
(Contract AF 33(657)-8784)
(ARF-B244-6; ASD-TDR-7-945(II))

Two shrink-fitted compound sleeve assemblies have been designed to supply required support for use of solid ceramic, ceramic-coated metal, and elevated temperature, metal extrusion liners, at stem pressures of 180,000 psi. Liner and sleeve machining and shrink-fitting data are supplied. The first assembly develops required support for ceramic liners and other materials which have high compressive strength and low tensile strength. The second assembly provides required support for materials which have modest elastic strain capability and/or strength in both tension and compression. A device has been designed for the rapid heating and accurate assembly of sleeves to be shrink-fitted. Author

N63-16047 Armour Research Foundation, Chicago, Ill.
LINER FOR EXTRUSION BILLET CONTAINERS Interim Technical Documentary Progress Report, 5 June 1962-4 Sept. 1962
S. A. Spachner Sept. 1962 19 p
(Contract AF 33(657)-8784)
(ARF-2244-3; ASD-TR-7-945(I))

A container-sleeve-liner assembly was designed which will provide adequate support for ceramic, ceramic-coated metal, or metal liners. The design minimizes mechanical property requirements of liner materials, and permits rapid removal of worn or damaged liners. A high-strength stem was designed and fabricated. Author

N63-16058 Aeronautical Systems Div. Flight Dynamics Lab., Wright-Patterson AFB, Ohio
HIGH-TEMPERATURE COMPOSITE STRUCTURAL CONFIGURATIONS: RADIATIVE THERMAL PROTECTION SYSTEMS FOR 2500° TO 4500° F
Robert D. Guyton *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 151–170 (See N63-16051 13-13)
(AF Proj. Asset)

Current programs and future plans for radiative thermal protection systems (2500° F to 4500° F) are discussed. Included are: program planning, a space reentry study, refractory metal structures, project asset, thermantic panel structures, high temperature composites, structural cooling techniques, and tungsten/tantalum frontal sections. N.E.A.

N63-16060 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURES FOR MANNED ENTRY VEHICLES
Richard R. Heldenfels *In* Little (Arthur D.), Inc., Cambridge, Mass. Proc. of [AFOSR] Conf. on Aerodynamically Heated Structures, Cambridge, Mass., July 25, 1961 p 197–218 13 refs (See N63-16051 13-13)

Problems encountered in the design of structures for manned entry vehicles are discussed, and solutions based on experimental and theoretical research results obtained at the NASA Langley Research Center are suggested. The general heating environment of manned entry vehicles is reviewed and the necessary elements of structures and thermal-protection systems for such vehicles are presented. The design of hot structures is considered in connection with the results of tests of a large research model. The strength of components of the model, effects of aerodynamic heating on panel-flutter, and the oxidation resistance of coated refractory metals are included. Characteristics of appropriate thermal-protection systems are described and their relative efficiency is compared. Tests results show the performance of selected systems under both convective heating and the combined convection and radiation heating encountered on return from lunar missions. Author

N63-16100 New York U. Coll. of Engineering, N. Y.
STUDY OF CONE-CYLINDER INTERSECTIONS Technical Report
Herbert Becker, Gerald Gurtman, and Angelo A. Colao May 1962 35 p 7 refs
(Contract NObs-78787)
(SM-62-6)

The three-and-one-half-year program of investigation of cone-cylinder intersections is reviewed. Results are summarized and engineering highlights are emphasized. Two basic design concepts of fundamental engineering importance are discussed, and a procedure is presented for design of an optimum ring-stiffened intersection. Author

N63-16311 Massachusetts Inst. of Tech. School of Engineering, Cambridge

EVALUATION OF TECHNIQUES FOR CONSTRUCTING MODEL STRUCTURAL ELEMENTS

Joseph Antebi, Harold D. Smith, Shyam D. Sharma, and Harry G. Harris May 1962 159 p 56 refs

(Contract DA-49-146-XZ-025)
(MIT R62-15; DASA-1287)

A series of tests on wire-reinforced–sand-cement-mortar model structural elements that simulate larger scale reinforced concrete shear walls and columns have been performed. The behavior and failure conditions of the model elements and larger scale elements which had been tested both statically and dynamically were compared. It is concluded from these experiments that it is possible and relatively easy to fabricate such elements—by the wire-reinforced–sand-cement-mortar technique. Preliminary results of model steel structural elements indicate that "phosphor bronze" holds promise as suitable model material for steel-framed structures. N.E.A.

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